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Prompt Delivery of Ship Machinery Imperative

WITH the rapidly increasing rate of production in the shipyards all doubt as to the ability of the shipbuilding industry to supply ships' hulls as fast as they are needed has been dispelled. But without the prompt delivery of machinery and equipment for the vessels the shipping programme may still fall short of its requirements. According to statements recently made by Director General Schwab before the American Boiler Manufacturers' Association, some eighty or ninety hulls are in the water waiting for various items of machinery and equipment. Failure in this regard, especially in the early months of the shipbuilding programme, would seem less excusable than delays in hull work, for at the outset there were available in the country ample facilities capable of being adapted to the building of engines, boilers and other marine machinery, whereas it was necessary to provide a large part of the shipbuilding facilities before the hull work could be begun. Every effort, of course, is now being directed by the government officials to this phase of the situation, and the encouraging announcement has been made that hereafter troop ships and freighters building for the Emergency Fleet Corporation are to have precedence in the supply of turbines over naval vessels. But until the marine engineering facilities of the country catch up with our enormously increased shipbuilding facilities the obligation will rest on all contractors and manufacturers engaged in this phase of the work to concentrate every available resource upon speeding up production.

May Shipbuilding Records

MAY ship deliveries in the United States totaled 44 vessels of 263,571 deadweight tons, while the May launchings included vessels of 344,450 deadweight tons, establishing records never before equaled in the history of American shipbuilding. The output in the United Kingdom in May amounted to 197,274 gross tons, and for the twelve months ending May 31, 1,406,838 gross tons. Against these production figures the total allied and neutral shipping sunk by German U-boats in May, according to Navy Department estimates, amounted to less than 260,000 gross tons.

The figures for this year's shipbuilding (in deadweight tons), as published by the Shipping Board for the United States and the United Kingdom are as follows:

	United States	United Kingdom
January	88,507	87,852
February	123,625	150,057
March	172,611	252,511
April	160,286	169,000
May	263,571	.....

The greatest year in the history of shipbuilding in the United Kingdom was 1913, when the output was 2,898,229 deadweight tons, or a monthly average of 241,519 tons. Last year, the United Kingdom produced 1,741,500 deadweight tons, or a monthly average of 145,125 tons. The best month was March, with 238,239 deadweight tons.

The output of May in the United States was three times that of January of the present year and brings the total deliveries since September, 1917, up to 170 vessels, aggregating 1,112,897 tons. The record pre-war year in American shipbuilding was 1901, when the output (exclusive of the Great Lakes) was 402,136 tons, or a monthly average of 33,511 tons.

That the record May output will soon be exceeded is indicated by the fact that no less than 89 vessels aggregating 439,886 deadweight tons are scheduled for launching on July 4. No effort will be spared to bring the monthly output up to half a million tons and when that goal is reached the expectations of the Shipping Board, as outlined by Chairman Hurley elsewhere in this issue, will have ample promise of fulfillment.

Effect of the German U-Boat Raid

IF the German submarine raid begun off the Atlantic coast on May 25 was designed to intimidate American shipping it failed signally of its purpose. During the interval while the raiders were destroying ten American vessels, totaling 26,000 tons, American shipbuilders were turning out 21 new vessels, totaling 130,642 deadweight tons, or over 100,000 tons more than the total losses. Further than this, the spirit of determination aroused in the shipbuilding and shipping industries will continue to react against the enemy until final victory is won.

Employment Men Wanted by the Shipping Board

THE Industrial Service Section of the United States Shipping Board Emergency Fleet Corporation is in need of men qualified to serve as employment managers, assistant employment managers and interviewers for shipyard employment work. Men of industrial experience closely allied to shipyard work are desired, who, after a six weeks' course in the fundamentals of employment management, will be in a position to render valuable service in shipyard work in the capacity of employment managers or assistant employment managers. For this work, men of good appearance and address will be required, possessing general intelligence, tact and other general qualifications which, combined with their industrial experience and training in employment work, will make them of immediate value as employment men. The second class of men required should also have industrial

experience closely allied to the shipbuilding trades, so that they can enter the employment departments of the shipyards as interviewers for selecting skilled shipyard help. Recruits for this work should communicate at once with C. W. Doten, acting head, Industrial Service Section, Emergency Fleet Corporation, Philadelphia, Pa.

Proper Designation for Pipe

REFERENCES to pipe in technical articles, specifications and elsewhere are too frequently inaccurate and misleading. There are three proper designations for pipe: wrought pipe, wrought iron pipe and steel pipe. Wrought pipe is the generic term for steel or iron pipe and is a proper designation for either. Wrought iron pipe means just what it says and refers to the product of a pudding furnace. Steel pipe also means exactly what it says but represents about 90 percent of the present output of wrought pipe in the United States. By reason of the fact that wrought iron pipe was the original pipe manufactured, the term is still erroneously used and the chances are ten to one that the product referred to by this term is in reality steel pipe, which, in the absence of definite information, should be termed "wrought pipe" and not "wrought iron pipe."

England's Merchant Marine Founded on Coal Trade

THE United Kingdom produced in 1913 only 22 percent of the coal production of the world but exported nearly 50 percent of the world's exports of coal, while the United States produced nearly 40 percent of the world's production and approximately only 12 percent of the world's exports.

If, however, only the sea-borne foreign coal trade be considered, the British over-seas trade in coal in 1913 was more than twice that of the whole world put together, or approximately 71 percent of the world's trade. All of the foreign coal trade of Britain is sea-borne, while the greater portion of the coal exported from the United States is shipped by rail into Canada, so that the share of the United States in the world's sea-borne foreign coal trade was in 1913 approximately only 4 percent. The significance of this situation is shown by the following extract from *Commerce Reports*.

The immense foreign coal trade of the United Kingdom, which reached a total of nearly 100,000,000 tons in 1913, is the foundation upon which has been built the entire foreign commerce of the country as well as the expansion of the mercantile marine. For the transportation of this coal, the building of an immense fleet of steamers was necessary. Without the coal trade, Britain would not have by far the largest mercantile marine in the world. According to Lloyd's Register for 1915-16, the merchant shipping of the world amounted to 49,261,769 gross tons, of which 19,541,368 tons were owned in the United Kingdom, the United States being next with only 5,892,639 tons, and Germany with 4,706,027 tons. The United Kingdom has been able to send its coal to all parts of the world at a cheap freight rate for the reason that the ships were always able to obtain return cargoes of raw materials needed for the manufacturing industries at home, such as wool, cotton, ores, and timber. In this way the outward freight on coal and the homeward freights on raw materials were low, thus making it difficult for countries like the United States to compete. The United States, not being a large importer of food or other heavy commodities suitable for return cargoes on coal exporting vessels, in exporting coal to foreign countries frequently was unable to obtain return cargoes and consequently the coal exporters had to bear the cost of the round trip.

Coal is thus the basis of Britain's mercantile shipping and manufacturing industry. Coal enabled British shipowners to obtain outward freights on vessels proceeding to foreign ports for needed raw materials; coal enabled British manufacturers to obtain low freight rates on imported raw materials, thus making it possible to manufacture at a cost so low that these manufactured goods could be exported. Without a great export trade in coal, Great Britain could not have become the greatest shipping country in the world and one of the greatest exporters of manufactured goods.

Since the outbreak of war Britain's exports of coal have so declined to South America that a largely increased market has been found for coal from the United States. Whether at the end of the war the South American market can be retained by United States exporters of coal will depend largely on the freight rates. If American ships taking coal to South America have to return in ballast, it will probably be impossible to compete with British rates. Every inducement, therefore, seems needed to increase the imports into the United States from South America. The establishment in the United States of free ports would assist greatly, as then South American products could be imported as return cargoes on coal-exporting vessels for storage free of duty in the free ports for re-exportation to Europe and other countries.

The United States is by far the greatest coal-producing country in the world. It is of vital necessity that large foreign markets be found for American coal. As has been shown above, coal is the basis of a great foreign trade. But a large export trade cannot be obtained unless there is also a great import trade; for otherwise shipping would have to bear the cost of steamers returning empty.

Stopping the Engines on Torpedoed Ships

CASES have occurred when vessels have been torpedoed and in immediate danger of sinking where it has been impossible to stop the engines due either to an escape of steam in the engine and boiler rooms or to the flooding of the engine room. The result has been that owing to the speed at which the vessel was moving through the water the ship's boats could not be launched or, if launched, were capsized on reaching the water and lives have been lost. It is, therefore, important that means be provided in all steamships for stopping the engines from the deck or the engine room skylight hatchway. The marine department of the Board of Trade points out this necessity and suggests three ways in which this can readily be done.

The first method is to connect a wire rope to the throttle valve lever (or the lever on the governor spindle in some cases), lead it to a point in or near the engine room skylight hatchway whence the lever can be operated and the throttle valve shut. Normally the rope is allowed sufficient slack to admit of the free movement of the lever in maneuvering the engines. A second method is by a simple arrangement of rods and wheel connected to the stop valve of each main engine for shutting the valve from the position indicated in the first method. Where there are few boilers a third method is suggested, consisting of fitting rods from the boiler stop valve to the top of the boiler casing, with suitable hand wheels for closing the valves from that position.

American Merchant Marine Will Total 25,000,000 Tons in 1920*

7,000,000 Tons of Shipping Now Under Control of Shipping Board—Present Programme Calls for 14,715,000 Tons Additional—819 Shipways in the United States

BY EDWARD N. HURLEY†

BEFORE the formation of the present Shipping Board Secretary McAdoo of the Treasury insisted that our pioneering upon the seas must in the future be done by an interest having boundless resources; an interest that is not compelled to concern itself with dividends to its stockholders, or returns to its bondholders; an interest that can afford to suffer losses and sustain them for an indefinite period; an interest that has a single purpose—the general welfare of the United States as a whole. Obviously, there is but one such interest, and that is the Government of the United States.

Before the war ocean commerce traveled in bottoms owned and operated by private capital. Now this gigantic merchant fleet which we are turning out is to be controlled by one central body by the greatest corporation in the Western World—the United States of America.

On July 1, 1916, we had no merchant marine worthy of the name engaged in overseas trade. It is true that we had under the American flag a total deadweight tonnage on that date of 2,412,381 tons, but approximately eighty percent of this tonnage was engaged in coastwise and Great Lakes trade. Therefore the vast supplies which we were sending abroad were shipped under terms and conditions laid down by other nations, because the great bulk of our exports was carried in ships flying foreign flags.

4,500,000 Tons of Shipping Added to American Merchant Marine

Now we are beginning to fulfill our destiny. On June 1, 1918, we had increased the American-built tonnage to over 3,500,000 deadweight tons of shipping. In the eleven months from July 1, 1917, to June 1, 1918, we constructed in American shipyards a tonnage equal to the total output of American yards during the entire previous four years. In short, the Shipping Board has added approximately 1,000,000 tons of new construction to American Shipping in the last ten months, for it was not until August 3d of last year that our commandeering order went into effect. We have also added 118 German and Austrian vessels, with a total deadweight tonnage of 730,176. We have requisitioned from the Dutch under the order of the President, 86 vessels with a total deadweight tonnage of 526,532. In addition we have chartered from neutral countries 215 vessels with an aggregate deadweight tonnage of 953,661. This tonnage, together with the vessels which we have been obliged to leave in the coastwise and Great Lakes trade, gives us a total of more than 1,400 ships with an approximate total deadweight tonnage of 7,000,000 tons now under the control of the United States Shipping Board.

In round numbers, and from all sources, we have added to the American flag since our war against Germany began, nearly 4,500,000 tons of shipping. We are adding to this tonnage rapidly and will continue to do so. It has taken us some time to apply to the shipbuilding industry of this country the principles of organization and progressive manufacturing which have made our other big institutions the marvel of the world.

Record May Production

Since January of the present year, when our new quantity production of ships may well be said to have just begun, we have steadily risen in our monthly output until in the month of May we turned out a total of 260,000 tons for that one month alone, making a total for the first five months of this year of 118 steel ships, aggregating 805,000 deadweight tons. Now, in the year ending July 1, 1915, the shipyards in this country built 186,700 deadweight tons of steel vessels of over 1,500 deadweight tons. Thus, in the month of May we produced 53,000 tons more than were produced in the entire year 1915. During the year ending July 1, 1916, 281,400 deadweight tons of steel vessels were delivered. Adding the 1915 tonnage with the 1916 tonnage gives a total of 468,100 tons. With a tonnage for the first five months of this year of 805,000 tons, we delivered in five months 336,900 tons of shipping more than was built in American shipyards in the years 1915 and 1916. I do not believe I am over optimistic in saying that our tonnage output will continue to increase until before this year closes we will be turning out a half million tons each month.

We have established a shipbuilding industry that will make us a great maritime nation. We have to-day under contract and construction 819 shipbuilding ways, including wood, steel and concrete, which is twice as many shipbuilding ways as there are in all the rest of the shipyards of the world combined. Our programme for the future should appeal to the pride of all loyal and patriotic Americans. In the early part of May the members of the Shipping Board appeared before the Appropriation Committee of Congress with a request for additional funds for our extended programme.

Present Programme Calls for 14,715,000 Tons

Our programme calls for the building of 1,856 passenger, cargo, refrigerator ships and tankers, ranging from 5,000 to 12,000 tons each with an aggregate deadweight tonnage of 13,000,000. We are also contracting for 200 wooden barges, 50 concrete barges, 100 concrete oil carrying barges, and 150 steel, wood and concrete tugs of 1,000 horsepower for ocean and harbor service, which aggregate a total deadweight tonnage of 850,000.

Exclusive of the above, we have 245 commandeered vessels, taken over from foreign and domestic owners, which are being completed by the Emergency Fleet Corporation. These will average 7,000 tons each and aggregate a total deadweight tonnage of 1,715,000.

This makes a total of 2,101 vessels exclusive of tugs and barges which are being built and will be put on the seas by the Emergency Fleet Corporation in the course of carrying out the present programme, with an aggregate deadweight tonnage of 14,715,000.

Five billion dollars (£1,025,000,000) will be required to finish our programme for 1918, 1919 and 1920 but the ex-

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* From an address delivered at commencement exercises at University of Notre Dame, South Bend, Ind., on June 10.

† Chairman of the United States Shipping Board.

penditure of this enormous sum will give to the American people the greatest merchant fleet ever assembled in the history of the world—a fleet which I predict will serve all humanity loyally and unselfishly upon the same principles of liberty and justice which brought about the establishment of this free republic. The expenditure of the enormous sum will give America a merchant fleet aggregating 25,000,000 tons of shipping.

American workmen have made the expansion of recent months possible and they will make possible the successful conclusion of the whole programme. On July 1, 1917, there were in the United States not quite 45,000 men engaged in the shipbuilding yards. To-day we have a force of 300,000 men in the yards, and 250,000 men engaged in allied trades. This force will be continuously increased. From all present expectations it is likely that by 1920 we shall have close to a million men working on American merchant ships and their equipment.

The Year's Output

The most liberal estimate of this year's output of shipping from all countries, except America, does not exceed 4,000,000 tons. One of the ablest shipbuilders in the United States, Mr. Homer Ferguson, of Newport News, predicted before the Senate Committee in January that out tonnage for this year would be 3,000,000 tons in the United States alone. Mr. Powell, vice-president of the Bethlehem Steel Shipbuilding Company, agreed with Mr. Ferguson. Mr. Schwab, the Director-General of the Emergency Fleet Corporation, has told me that he is going to prove that both of these good friends of his are somewhat conservative. He believes that the expert prediction of 3,000,000 tons can be exceeded, and I agree with him.

We have gradually reached the point where we have the facilities for constantly increasing our output.

As I have said, we have a total of 819 shipways in the United States. Of these 819, a total of 751, all of which except 90 are completed, are being utilized by the Emergency Fleet Corporation for the building of American merchant ships.

751 Building Ways for Cargo Ships

In 1919 the average tonnage of steel, wood and concrete ships continuously building on each way should be about 6,000 tons. If we are using 751 ways on cargo ships, and can average three ships a year per way we should turn out in one year 13,518,000 tons, which is more than has been turned out by Great Britain in any five years of her history.

When all our wood, steel and concrete shipyards are thoroughly organized, with a keel laid on each of the 819 ways, our fabricating plants driving ahead at full speed, and employees more thoroughly trained in the art of ship construction, it is estimated that we can turn out from each way more than three ships a year.

The United States Shipping Board is not only the greatest shipbuilder in the world but is the greatest ship operator. In perfecting our organization we not only perfected that part of it which is building the ships but we have also another part which operates the ships. The operating side is called the "Division of Operations;" under the management of Edward F. Carry, Director of Operations; its function is to see that all the ships in the service are well managed and that rates are properly adjusted. The great shortage in the world's tonnage and other courses brought about extremely high ocean rates. These high ocean rates have been felt in the rising prices of all seaborne commodities. One of the most important phases of the work of the Division of Operation has been to lower ocean rates as much as has been possible. One result of this reduction has been to make it possible for our Allies to receive their necessary munitions and supplies at much less cost.

The total gross revenue of our fleet is very impressive. From the ships under the control of the Shipping Board a total gross revenue is derived of about $360,000,000 (£74,000,000), an amount more than the gross revenue of the New York Central Railroad and almost equal to that of the Atchison, Topeka & Santa Fe Railroad, and the New York Central Railroad combined.

Shipping Control Committee

The Shipping Control Committee, composed of Mr. P. A. S. Franklin, chairman, Mr. H. H. Raymond, and Sir Connop Guthrie, K. B. E., was appointed in the early part of February, 1918, jointly by the Secretary of War and the United States Shipping Board. The appointment was the outgrowth of several months' experiment, and which had clearly demonstrated the necessity of having the entire merchant fleet operated under a single head with the one object of winning the war. Since its appointment the committee has directed the movement of all supplies destined for the troops overseas, which, considering the vastly increased army now in France, is a very great accomplishment. The committee has also operated vessels under requisition of the Board and has chartered neutral shipping to carry essential raw materials to manufacturers in the United States and the various commodities needed here and abroad. Nitrates have been brought from Chile, manganese from Brazil, chrome from New Caledonia, hides and wool from the Argentine, sugar from the West Indies and Porto Rico, and various other essentials from all parts of the world. The committee has also supplied vessels to take care of the desperate food situation in Belgium.

If in 1919-'20 we have the passenger and cargo tonnage we have planned, we will be in a position to establish a weekly passenger service between New York and Rio de Janeiro, Montevideo, Buenos Aires and Caracas on the east coast, and weekly service between Colombia, Ecuador, Peru and Valparaiso, Chile, on the western coast. On the west coast we now have two fast passenger steamers plying between New York and Valparaiso. These are the first to carry the American flag on that route. They have cut the time between these two important cities from 27 to 18 days—a saving of 9 days.

New Steamship Service

Our Central American neighbors, Mexico, Guatemala, Nicaragua, Honduras and Costa Rica must all have the very best passenger and cargo service, as must all of our South American neighbors. We have planned the class of steamers required for this service. The type will serve our Latin American friends in a manner that they have never been served before, but which they are entitled to. With the wonderful resources which these countries have, their products should be distributed in the world's markets and they should have sufficient ships at their disposition and at such rates that will enable them when it is necessary, to sell their products in competition with other nations. This will give them an opportunity to receive their share of profits which will permit them to further develop their countries.

On the Pacific we must provide sufficient tonnage to meet Russia's requirements. That country has many products which we need. These articles can be moved in

bottoms controlled by us at fair freight rates and this will be most helpful to the expansion of Russia's trade.

China also has many commodities which we require, and should receive the transportation necessary to move them, not only to our country, but to other countries that she may desire to sell to.

What better use can we make of our merchant marine than to assure to these countries the best possible regular steamship service?

That progressive nation, Japan, is rapidly upbuilding her own merchant marine, but the demand for tonnage will be so great on the Pacific that Russia, China, Australia, and other foreign possessions will receive service which they have never been able to receive before.

Terminal Facilities

The building and operating of vast fleets for the United States is not the only work the Shipping Board is doing to create and develop a great merchant marine. Linked to this work is the work done by the Board in helping to develop our harbor and port terminal facilities. A Port and Harbor Commission has been appointed with Mr. Edward F. Carry as chairman, and in co-operation with the Army, Navy, Railroad Administration and Shipping interests we expect to develop and organize our harbors so that the great merchant marine we are creating will have full facilities for speedy loading and unloading, and for the dispatching of cargoes into the interior and the receiving of cargoes from the interior. With that development of drydocks and bunkering and repair facilities, we shall have the most modern improvements, which will enable us, in co-operation with the railroads, to load and unload ships quickly, thereby saving time and preventing delays of our ships in port.

All the warring nations now recognize that the chief issue which Germany will raise when compelled to sue for peace will be the issue of raw materials. There is indisputable evidence that this is now the principal fear of the German industrial and financial leaders. No nation can participate in the commerce of the world without an adequate supply of raw materials. Manufacturing nations must have oil, cotton, copper, steel and iron, if they are to survive industrially.

A neutral diplomat who has spent some time in Berlin recently brought back to Washington a report of the physical breakdown of Mr. Albert Ballin, managing director of the Hamburg-American Line, once the shipping master of Germany. Mr. Ballin, prior to the European war, was one of those who recognized that the Prussian military leaders were set upon trying out their military organization. He had expressed the opinion that it was inconceivable that the Kaiser would agree to such a cold-blooded project, especially as Germany had such a great merchant marine and all the place in the sun that any reasonable nation could desire. Mr. Ballin did not reckon with the character of a nation which had been taught for generations that whatever it wished to do could be achieved by military power alone.

Mr. Ballin is one of the victims of the German system of militarism. The merchant marine which he built up is swept from the seas. The instruments which might have been of service to the German people, had they used their strength for peace instead of war, are now stripped from them. Mr. Ballin, I have been told, is a physical wreck. Germany herself must become a wreck, by her own acts, if the war continues. She has been forced recently to commandeer the copper from household plumbing; the doorknobs, kettles, bathroom fixtures, and even the extra suits of clothing possessed by her citizens. This is her internal struggle for raw materials. In peace, as well as war, she must have the raw materials which other nations produce, or she cannot recover industrially. In the end, raw materials will mean more to her than the military map to which Hindenburg and Ludendorf have glued their eyes.

Government Attitude on the Concrete Ship

Congress and Shipping Board Open Minded as to Concrete Ship Construction—Merits of New Type of Vessel Must Be Proved

BY WALDON FAWCETT

WHAT is the United States Governmental attitude and more especially the Congressional attitude on the concrete ship proposition? This is a question which has been asked very frequently during the past few weeks; and assuredly it is pertinent, since the extent of the concrete shipbuilding programme must, perforce, be dependent upon Congressional authorization and Congressional appropriation. It is a question which is, furthermore, entirely excusable by reason of the fact that with the single exception of aeroplane construction no wartime proposal before the national government has induced more argument at Washington than this self-same concrete ship programme. It would doubtless be unjust to say that it has been an incentive to lobbying, but it has at least been the objective in political as well as engineering maneuvers and has revealed the steel manufacturing interests arrayed against the cement interests with an eye to future business in materials.

To answer, as well as may be, the question in the preceding paragraph, it may be said that, by and large, executive authority at Washington is receptive, unconvinced, but of absolutely open mind, albeit hopeful, with respect to the concrete ship. There are, of course, enthusiasts in the United States Shipping Board Emergency Fleet Corporation who feel that the trial trips on the Pacific of the *Faith* fully vindicate the concrete ship, but the general attitude in administrative circles at the seat of government is one of waiting for more conclusive results.

Forty-two Concrete Ships Authorized

Hesitancy to commit the Government, unreservedly, to a policy of maximum production of concrete ships does not signify, however, grudging consent to a comprehensive demonstrational programme. The best evidence in refutation of that is found in the fact that the Shipping Board has authorized the construction of a total of forty-two concrete ships, of which eighteen are already under contract. Nevertheless, there has plainly been suspicion on the part of champions of the concrete ship, both in Congress and in the shipbuilding industry, that obstructionist tactics were being employed at Washington to deny full recognition to concrete construction. This was the

explanation, in part at least, of the recent move designed to secure a special Congressional appropriation of $50,000,000 (£10,250,000) for the construction of concrete ships.

When there was disclosed in the Committee on Commerce of the United States Senate a spirit of opposition to such heavy expenditure at this time for concrete ships the attitude was misunderstood by a considerable portion of the public and interpreted as expressive of prejudice against concrete ships. As a matter of fact the underlying motive was one of resentment not at the proposal for concrete ships but because of the attempt to (by reference to another Senatorial committee) take the concrete ship proposition out of the hands of the body which has up to this time handled all the legislation relative to the Governmental plan for building up the mercantile marine. In other words it was a political rather than a technical monkey wrench that had been thrown into the machinery.

Not Antagonistic to Concrete Ships

As a matter of fact the Commerce Committee has, at no stage, been antagonistic to concrete ships, and for all that the fact has never become public, this body weeks ago authorized by the Emergency Fleet Corporation to go ahead and expend any sum up to $10,000,000 (£2,050,000) for the construction and test of concrete ships. The Senatorial "board of directors" did not create a special fund for a try-out of concrete construction, but it did, in effect, advise the Governmental shipbuilding organization to go ahead and expend any sum up to $10,000,000 (£2,050,000) from the general fund at its disposal with the assurance that if, after the expenditure of the $10,000,000 (£2,050,000) it developed that the concrete ship was a disappointment there would be no question raised by the Senatorial supervisors of the shipbuilding programme regarding the wisdom or justification for the expenditure.

Regret was expressed in shipbuilding circles when premature announcement was made that all of the concrete ships to be constructed to the order of the Emergency Fleet Corporation would be tankers. The misgivings as to the narrowness of the range of demonstrational service thus afforded were, however, unjustified. To be sure, a majority of the 42 ships sanctioned by the Shipping Board will be tankers of 7,500 tons to operate at a calculated speed of 10½ knots, but a certain proportion of the vessels will be cargo ships of 3,000 to 3,500 tons. The engineering qualifications and the adaptability of the concrete construction will be even more diversely tested by supplemental programmes of construction in which other branches of the United States Government are following the lead of the Fleet Corporation.

Diversity of Types

As different as may be, for instance, from the service required of the concrete craft in the fuel oil trade will be the exactness imposed upon concrete tugs and barges in commission in deep-water harbors and upon American inland waterways. Such versatility of application is, however, in immediate prospect. At the request of the Inland Waterway Commission, the Department of Concrete Ship Construction of the Emergency Fleet Corporation has prepared plans for a 500-ton concrete tow barge and the Commission proposes to place not less than a score of towing craft of this type in commission on the Erie Canal. Meanwhile the Bureau of Construction and Repair of the Navy Department contracted for twelve concrete barges of 500 tons each, for harbor service, and the Quartermaster's Department of the War Department announced that it would accept concrete as an alternative for wood in tug construction, the initial concession in this respect on the part of the War Department being made in connection with an order for twenty-two tugs.

Cost of Construction

Students or observers within the shipbuilding industry of the progress of the idea of concrete construction will naturally watch with especial interest the effect of climatic conditions, etc., upon actual construction. The weight of this factor should be conclusively determined, it would seem, by the location of concrete shipyards at points so diverse at Wilmington, N. C.; Jacksonville, Florida; Mobile, Alabama; San Francisco, Cal.; San Diego, Cal.; New York City, and Brunswick, Georgia. Disclosure of cost figures covering building operations on a large scale will likewise be awaited with the keenest curiosity. One of the prime advantages claimed by advocates of concrete ships is the alleged economy of construction. Their contention has been that the new concrete ships could not show a cost in excess of $110 (22/18/4) per ton as compared with $165 (34/7/6) per ton ascribed to wooden construction and an estimate of $180 to $220 (37/10/0 to 45/16/8) placed upon steel ships. Set over against any advantage that the concrete ship may show in initial cost will have to be the allowance for more rapid depreciation if it should prove that, in salt water, concrete will show a more rapid rate of deterioration than wood or steel.

Books for All Men in United States' Service Are Provided by the Library War Service of the American Library Association

At the request of the War Department Commission on Training Camp Activities, the American Library Association has undertaken to supply reading matter to the men of our army and navy, wherever they may be. This service extends to 39 large camps, to small camps and stations, to vessels, hospitals, transports, and overseas. It is the aim of the service to send books to every point where U. S. soldiers, sailors, and marines are stationed.

Books and magazines of all kinds are available; good stories; technical books on military tactics, electricity, machine shop work, trench fighting, aeronautics, automobiles, gas and such subjects; poetry; biography; books about the war; in fact, all books that men like to read.

If there are no A. L. A. books in any place where men are stationed, all that is necessary to obtain them is to send the following data to the Library War Service Headquarters, Library of Congress, Washington, D. C.

Name and address of camp (or vessel).

Kind of camp (or vessel).

Approximate number of men in camp (or on board).

What agencies are supplying reading matter and to what extent.

What local library, if any, is co-operating.

How many and what kind of books are needed.

How many magazines are needed.

Where will reading matter be housed.

Who should be notified when books and magazines are shipped.

Will he arrange for the circulation of this reading matter throughout the entire camp (or vessel).

There is no red tape about getting the books; men in charge will be asked to keep simple records, instructions for which are furnished with each library.

The Big Concrete Ship Not Unreasonable

A Reply to Professor Everett's Article on "The Fallacy of Concrete Ship Construction"—Views of an Advocate of Reinforced Concrete Vessels

BY J. F. SPRINGER

IN the February issue appeared an article entitled "The Fallacy of Concrete Ships." This article comes from the pen of Professor H. A. Everett, who holds the chair of Marine Engineering in the Post Graduate Department of the United States Naval Academy. Perhaps the author's attitude is not so well expressed by the title as by the concluding words. They read:

"To sum up briefly, we are justified in expecting success for reinforced concrete construction for barges, still-water craft and perhaps small ocean-going craft of simple form, but are entirely unjustified at the present time in expecting large ocean-going craft to be successful, and should not be led astray by undue optimism."

In the same issue of MARINE ENGINEERING appeared an extended statement of the plans and specifications relating to a 5,000-ton reinforced concrete ship, which has, in the short interval, since been launched and successfully undergone harbor trials. This ship is named the *Faith*. It is far and away the biggest commitment to reinforced concrete for ship construction. Was the building of this vessel justified "at the present time"? I understand Professor Everett in effect to say No. It is possible, however, that the builders knew some facts of which, or of whose significance, the professor is still unaware. The name *Faith* suggests that they did not have full knowledge and it also suggests that they knew enough to be confident.

Basis of Confidence in Concrete Ships

It may be profitable to set forth the grounds on which our confidence may rest in respect to such ships. The present writer is not a ship designer. His point of view is that of one more or less acquainted with concrete and its characteristics. Probably, nearly everyone now considering this question which is bringing together two differeent lines of development will be handicapped by knowing something less than an adequate amount in one or the other. Professor Everett has given, presumably, a conception of the status of affairs as viewed by one who is more or less of a stranger to the history of concrete. I propose to make some contribution from the side of the new material.

Concrete is old, not to say ancient. Reinforced concrete is a new thing in the world. There may have been some sporadic cases in the somewhat distant past of iron imbedded in concrete. But reinforced concrete means more than a juxtaposition of concrete and steel in a single mass. Steel itself consists of two things, iron and carbon. And yet it is neither the one nor the other. It is much the same with reinforced concrete. It is a new material that is neither plain concrete nor steel. Plain concrete is fairly strong in compression; so much so, in fact, that it is extensively used for foundation purposes. But it is weak in tension. There are no suspension bridges of plain concrete. Reinforced concrete is the result of successful efforts to make good this deficiency in an otherwise splendid construction material. Steel has wonderful tensile strength. Furthermore, the coefficients of linear expansion of plain concrete and steel are approximately the same (being in the neighborhood of 0.0000055 and 0.0000066 per degree F., respectively). Reinforced concrete consists of the plain material in which have been imbedded comparatively small amounts of steel in locations where tension stresses are to be expected. Thus a beam which is to be loaded on top needs little or no reinforcements in the upper part but does require its presence in the lower part. The natural compressive resistance of plain concrete takes care of the purely compressive stresses in the upper part, while the steel takes the tension load in the lower part.

In a ship, the reinforcement will naturally be located where there will be tension stresses. Where compression reigns alone, reinforcement will ordinarily be unnecessary.

Reinforcement for Tension Stresses

Now a concrete ship, like many other structures, is made up of parts, some of which are perpetually or occasionally subject to tension stresses, and of other parts where they do not occur. Probably, in so complex a thing as a big ship, the designer may not everywhere be able to assign the precise maximum tension stresses that will occur and will, in consequence, be driven to the safe course of using at these points unnecessary amounts of steel. Similarly with compression stresses, it is to be expected that they will not everywhere be known with exactness and that the designer will be compelled to assign excessive cross-sections of concrete at this point and that, in order not to introduce risk. That is to say, we may expect the first big ships to be overheavy on account of the excessive amounts both of concrete and of steel. It is reasonable to regard the objections to concrete ships which are founded on the weight of the structure to become less pertinent with the growth of knowledge.

The specific gravity of concrete is around 2.25. The reinforcement will not add greatly to this. Naturally, it will vary between wide limits. For an average, I make the guess of 3 as an outside figure. With steel at 7.85, we may see at once that we may make the shell of the hull 2½ times as thick as a steel one and not increase the weight. It will be seen, then, upon consideration, that while 3 to 4½ or more inches may be required for the thickness of the concrete shell, this will not mean such an enormous addition to the weight.

Concrete Vessel Heavier than Steel

Similar remarks apply to frames and other auxiliary numbers. Doubtless, a reinforced concrete vessel of the same deadweight-carrying capacity as a steel vessel will be bigger and heavier. This is granted. But attention should be focussed upon the point that the excess displacement grows proportionately less as the carrying capacity goes up. In short, the big ocean-going stone ship exceeds the steel sister vessels to a relatively smaller extent than does the small boat. This point has been well brought out by T. J. Guerrite, in his article on Ferro-Concrete Ships, published on page 328 of the June issue. The data for the steel ships come from members of the staff of Messrs. Sir W. G. Armstrong, Whitworth & Company, Ltd., and for the concrete vessels they have been calculated by M. Guerrite in collaboration with a member of the staff of Messrs. Vickers, Ltd. For steel and concrete ships of 1,000 tons deadweight carrying capacity, the stone ship

exceeded in displacement by 39 percent. Corresponding to 2,000 tons capacity, the excess displacement diminishes to 25.8 percent; while for 4,000 tons capacity, the excess amounts only to 16.5 percent. When we get to the big 6,000-ton ship, the reinforced concrete boat exceeds the steel vessel in displacement only 11.8 percent. In so far, then, as the weight of the ship is concerned, the acceptability of reinforced concrete is greater than the biggest vessel. There is, from the point of view of weight, apparently no point in Professor Everett's optimism in favor of the little vessel when that optimism is conjoined with pessimism for the big fellow. In fact, if the little one is all right in respect to weight, we are to expect the big one to be much more so.

The equipment that goes onto a reinforced concrete vessel is heavier than what is needed for a steel vessel of the same carrying capacity. The total weights of the finished vessels when compared make manifest a disadvantage on the side of the stone craft. But just as the relative excess weight of the naked vessel went down as the carrying capacity went up, so here. The small concrete boat equipped is twice as heavy as the steel vessel of the same carrying capacity. But this great relative excess goes down to about 40 percent when we reach the 6,000-ton vessel. So, then, even when we take equipment into account, we find that the big reinforced concrete ship is decidedly more acceptable than the small one. In view of what has now been said, it is difficult, in so far as weight is concerned, to see any reason why we may expect success with the small boats but not with the big ones. The argument is, in fact, the other way.

Factors Affecting Net Ton-Mile Costs

No one can very well claim the excess weight of a concrete ship, on the whole, an advantage. It may, however, very well have a compensation in the way of stability. Be that as it may, let us grant at once that the prospects are that the concrete ship, because of its greater weight, is going to be a slower ship than the steel vessel. Probably, ocean greyhounds will never be built of concrete. The stone boat will doubtless begin and end as a cargo carrier. The question is whether reinforced concrete promises a solution of shipping difficulties that will enable it to develop and retain for itself a special field. Probably greater weight is going to mean greater power costs per ton-mile. But the ultimate net ton-mile cost is determined only after the consideration of a good many items. Of these, power cost is but one, although an important one. Another item, which also is only one, but which is also quite important, is that which prorates the yearly charge set down to cover the depreciation of the vessel. Here is where we may expect to get a very substantial offset to the power cost. Concrete vessels may be expected to be long-lived craft. We cannot, of course, point to actual cases of big ocean-going reinforced concrete ships that have had long lives. The *Faith*, the first 5,000-ton stone ship has only just gone into service. Steel vessels were under this same handicap at a like stage of development. Still, there is a good deal of information pertinent to this question. Reinforced concrete is, admittedly, a material of indefinite life under favorable conditions. Indeed, we have a good example of this in the case of a reinforced concrete boat where the conditions have not been so very favorable. In 1849, a rowing skiff of reinforced concrete was constructed. In 1917, it was reported to be still in existence and still in its original condition. If water is going to penetrate into concrete and cause the steel to rust and consequently expand, and such expansion is going to rupture the concrete, this boat has given the water and the rust a good long time to do whatever they are going to do. Doubtless, Mons. Lambot's skiff floated only in fresh water, and has not been subjected to certain chemical activities which some seem to think sea water may be able to set in motion. However, I am not relying on this boat as affording the whole ground for expecting the *Faith*, for example, to outlive contemporary wooden and steel vessels. But the little skiff bears its quota of testimony in favor of long life.

Damage and Deterioration

There are, it would appear, two principal sources from which damage and deterioration may conceivably come. These are mechanical shocks and chemical disintegration. We have, with respect to the former, no experience with big concrete ships upon which to fall back. But there is a good deal of experience with reinforced concrete in miscellaneous structures. I call attention, first of all, to the common practice of driving reinforced concrete piles by means of the blows of a pile driver. There is more or less cushioning by means of blocks interposed between the hammer and the pile head. At the same time, the penetration of the pile is derived from the shock of the blow. This practice is nothing new nor novel. It is a very usual thing. There may be a disposition to grant that this illustration certainly favors the idea that reinforced concrete may be constructed to resist successfully tremendous blows, provided they are deadened somewhat, but that it does not show a capability of resistance to a very quick and powerful blow. Very well, let the example be restricted to deadened shocks. I am content. This isn't my last example. But let us stick, for the moment, to slow acting forces and shocks. A monolithic, reinforced concrete building was in 1909 erected on 20 piers in a region where subsidence was a contingency. Six years later, sure enough, subsidence was detected. Inspection made it clear that the building had lost contact with 12 of the piers and was then being supported by only 8 out of the original 20. This must have created tremendous overstrains through the building. The report summing up the results of an examination into affairs said: "Thorough inspection of the whole building, with special attention to main beams, secondary beams and ceilings, failed to reveal any trace of weakness or strain." It hung together, didn't it? Take a similar case, only this time with a reinforced concrete boat built by a Norwegian concrete-vessel concern. The boat was a lighter of 100 tons deadweight, which measured 64 feet between perpendiculars and weighed 58 tons. This vessel, when the deck concrete was 50 days old and that of the sides 30,* was provided with supports at the two ends, leaving an unsupported gap of 40 feet and having a load of 16 tons distributed evenly over the central part. The maximum total shear is estimated at 26½ tons at the inner edges of the supports, and the maximum bending moment at 419 foot-tons at the center of the span. At this center, a deflection of about 1/16 inch was noted. "There were no signs of surface cracking, flaws or weakness of any kind." One more slow-acting test of reinforced concrete. A large pier of this material was rammed or jammed by a big vessel of 8,000 tons. It is said that a timber pier would have given way to the point of letting the steamer through. "As it was, the only damage was the destruction of a few piles and about 20 square feet of decking."

Quick and powerful blows will, naturally, penetrate anything if there is plenty of rapidity and plenty of force.

* Some may wonder at the deck concrete being older than the concrete in the sides. This probably arose from the custom of this particular concern in pouring concrete vessels in an upsidedown position.

That is the way *steel* ships are pierced by shells. Not only the steel hull, but heavy armor as well. We can hardly hope that reinforced concrete or any other material will prove to be the "immovable object" capable of withstanding the "irresistible force." Steel and wood are not such materials, at any rate. An advantageous thing about swift forcible blows is that the region of damage is, with some materials, concentrated, and the surrounding construction left unharmed. Perhaps the steel hull of a ship belongs among these materials. Let us grant it. But so also does reinforced concrete. About a year and a half ago, a big explosion occurred at a British port, which threw up into the air a steel girder weighing nearly 1 (long) ton. This girder came down endwise on a reinforced concrete wharf. "It went through a panel of the decking, but the hole made was hardly more than 1 foot by 2 feet, the adjoining beams not suffering in the slightest; the damage was therefore insignificant and most easily repaired." Consider another case of quick, powerful action. On the western front in the region defended by the British was a reinforced-concrete water tower, 52 feet tall. It stood on the German side. When the Germans fell back in the spring of 1917, they dynamited the legs and brought the tank down. It fell, in fact, the full distance to the ground. "But according to written statements the shells which had struck the tank merely made circular holes through the sides and bottom....."

Effect of Mechanical Mishaps Localized

We are, I think, entitled to draw the conclusion from the foregoing examples of the behavior of reinforced concrete, when subjected both to sudden and to cushioned shocks, that at the most only local effects are to be expected from the great majority of the vicissitudes which happen to a ship in and out of port. I may close the discussion of mechanical mishaps by telling of the collision of two small reinforced concrete vessels in the Balboa dry dock basin. The vessels were pontoons 120 by 28 by 18 feet in size. These pontoons broke away from their moorings and came into violent collision with each other. One pontoon suffered no damage at all. The other pontoon had its fender carried away, the bolts having been pulled out.

We now come to the question of the possibility of disintegration and rupture of reinforced concrete through activities due to or set in motion by chemical action. Will salt water penetrate reinforcement? Will it bring about disintegration of the concrete through chemical reactions between its own ingredients and those of the concrete? Will the reinforcement attacked by the salt water become corroded, expand in consequence and thus disrupt adjoining concrete? These are serious questions which must, on the whole, have favorable answers, or reinforced concrete ships will be doomed to failure.

Action of Salt Water on Reinforced Concrete

Let us grant at once that probably all the bad things suggested as possible by these three questions will occur with concrete that falls distinctly short of being the best modern product. Concrete is made from three solid materials. All the ingredients are cheap, except one. It so happens that this expensive one is the only one that acts as a binder. Many contractors have undoubtedly tried to reduce the amount of Portland cement which went into the structures they were engaged upon. This was probably truer of a bigger percentage of responsible contractors some years ago than it is now. People know more about concrete to-day than they did a few years back. It is now coming to be understood, at least in effect, that unless there is sufficient cement to fill *all* the voids left between the pieces of sand and rock, then there will be produced a porous concrete. In fact, more cement than enough has to be put in to counteract the inevitable imperfections of mixing. Naturally, for the hull of a ship, the open decks, and any parts exposed to the action of sea water, we must use a highly dense concrete—one in which the porosity has been eliminated or reduced to a minimum. We cannot save on cement, but must use the amount which the best concrete practice indicates for dense concrete.

Dense Concrete Essential

Now, in general concrete practice, it is very often unnecessary to put the owner to the expense of ultra dense concrete. The interiors of heavy foundations and thick dams may not call for it. Buildings that stand for the most part in a dry atmosphere may not need to have the densest of concrete employed in their construction. It is probable, however, that, scattered over the country, is a big total of reinforced concrete construction which is not fully adapted to the service which it is called upon to perform. This is, in the case of important structures, more apt to be the case with buildings, piers, dams, wharfs, etc., constructed 10, 15, 20 years back than with structures recently built. Less was known then than now. We have in America, doubtless, allowed much construction by incompetent engineers and contractors.

Mr. H. S. Taft, in a paper on "Reinforced Concrete Docks," published in the *Transactions, American Society Civil Engineers* for 1915 (volume 78, page 1058), says: "In the United States the construction of reinforced concrete docks is in a very embryonic state, and the use of cement in structures standing in sea water, on the part of American engineers, has not always been successful. On the other hand, concrete has been used successfully for more than 50 years in Europe for structures exposed to the action of salt water, and English engineers have been building reinforced concrete docks for about 20 years."

Concrete Docks Successful

In discussing the question of concrete docks, a prominent New York engineer has stated: "Of the large number of concrete docks which have come under his observation, the majority have been a success, though here and there he reports a failure, due to poor construction and material, and not to defects in the design. It is authoritatively stated that the reinforced concrete docks at Southampton have shown no deterioration due to salt water action, except at the Southampton coal jetty. The engineers of the Liverpool Docks have been using concrete in connection with their work since 1872, apparently with great success.

It has been stated on the best authority that in England the alteration of 'dryness and wetness and fluctuations in temperature' does not appear to have affected reinforced concrete sea water structures adversely." In discussing the concrete docks of the Port Talbot Dock Company, Mr. William Cleaver has stated: "While reinforced concrete requires extreme care, both in the choice of material and in the supervision of the workmanship, the results justify the extensive adoption of the material for dock work."

Experiments by Mr. Baldwin-Wiseman in 1907, in England, on the permeability of concrete, show that, if it is well made, it is one of the most water-tight materials known, and that it rapidly becomes less and less porous when water is forced through it. Mr. V. de Blocq van Kuffeler, in summing up the experience in using concrete for salt water structures in Holland, says: "A suitable mixture, very carefully manufactured, the use of a good

brand of cement with trass,* and setting in a moist atmosphere, are the most efficient means of insuring the preservation of reinforced concrete in sea water."

In discussing the deterioration of steel in reinforced concrete by the action of sea water on ferro-concrete,† provided the latter is properly made, Mr. C. S. Meik, a prominent concrete engineer of England, says that such deterioration "is a negligible quantity." In support of this contention, he cites the experience at Southampton, stating "that the exposed steelwork on a pile end that had been in the sea for 8 years was much corroded," whereas the bars in the body of the concrete, on being cut open, were forced to be quite free from any rust and as fresh as the day they were put into the pile.

Professor Everett depends, in a large measure, upon an article by Professor H. J. M. Creighton on "The Deteriorating Action of Salt and Brine on Reinforced Concrete" which appeared in the *Journal of the Franklin Institute* for November, 1917. Professor Creighton relies upon his own investigation in large part, but depends in part upon others. Amongst these others is H. P. Brown, the author of an article in *The Electrician* (London), volume 69, page 915†† (1912), on "Electrolysis of Reinforced Concrete." Professor Everett is unfortunate both in his dependence upon Professor Creighton and upon Mr. Brown.

Professor Creighton's Investigations

Professor Creighton's investigation supplies quite a number of examples of deterioration which he himself has viewed They are sufficient to refute any claim that might be made to the effect that any and all reinforced concrete is impervious and will successfully resist the action of salt water. And that is about all of which it is a refutation. But, who claims that any and all reinforced concrete had such fine qualities? The present writer does not. Nor does he know of any responsible person acquainted with reinforced concrete who does make any such preposterous claim. Professor Creighton doesn't say, in so many words, "any and all," but he does the equivalent. He lists example after example without giving any real, substantial information either as to the quality of the materials that went into the concrete or as to the proportioning of the mixtures or as to any other steps that were taken or omitted which may have had in view the waterproofing of the material. In one single case, that of a thirty-years old concrete in a building in Kansas City, Professor Creighton tells us something of the character of the concrete. He states in effect that this concrete was made with *cinders.* This is a bad chicken to come to roost for Professor Everett. About the only reason that anyone could have had to use cinders was to *save money.* The presence of cinders in a concrete, at least at a point of time 30 years back, is about sufficient to condemn the concrete as probably of very inferior quality indeed. The remaining concretes of Professor Creighton's investigation are unknown quantities. This investigation, in its present state, is to be regarded as having no value for Professor Everett's purposes, as those who seriously advocate big concrete ships do not propose to construct them of anything but high quality material.

Mr. Brown's article, abstracted in *The Electrician,* is concerned with the effects of electric currents accidentally traveling along the reinforcement. If the mass of concrete is damp the currents will bridge the gaps from bar to bar and we get electrolytic action. Salt water would doubtless accentuate the bad effects. It is desirable, then, to waterproof the concrete, and this brings us to Mr. Brown's interest in waterproofing materials and compounds. Professor Everett in MARINE ENGINEERING, page, 62, correctly quotes Professor Creighton:

"Regarding the waterproofing of concrete, it should be pointed out that an impervious concrete is probably never obtained outside the laboratory. The average concrete is practically never waterproof. Although there are many substances on the market for rendering concrete waterproof, the majority of them are far from satisfactory. A number of such instances has been investigated by Brown (*The Electrician,* 65, 615, 1912), who points out that all waterproofing materials will sooner or later hydrolize, crack or distintegrate."

Mistaken Conclusions

The one professor correctly quotes the other (except for the "615"), but, apparently, the first never looked up Mr. Brown's article, and the second got, I think, a wrong impression. Mr. Brown does not state, either explicitly or implicitly, "that all waterproofing materials will sooner or later hydrolize, crack or disintegrate," as Professor Creighton makes him say, in effect. What Mr. Brown does say is this: "Permanent protection from electrolysis cannot be secured by painting or by coating a concrete structure with a membrane and waterproofing material. These will sooner or later hydrolize, or crack from settlement of structure, or disintegrate from action of gas liquor in the water." Some waterproofing materials are incorporated in the mass of the concrete and really form one of the ingredients of the mixture. These are known as *integral waterproofing* materials. Mr. Brown says, in this passage, nothing as to them. He speaks of "coating a concrete structure with a membrane and waterproofing materials." This is something else. Integral waterproofings are not applied as coatings. But Mr. Brown goes further than an expression of his disapproval of superficial waterproofings. He mentions in this article, which I commend to Professor Everett, that he did find a waterproofing substance whose action had been—up to the time when he wrote the article—perfect. He needed to find a material which when mixed with the concrete would prevent internal dampness to the extent of maintaining the insulation between steel reinforcing bars supplied by the imbedding concrete. He subjected a test block, made by mixing, with the water, sand and cement of a cement mortar, a small amount of the inexpensive paste which he names, to a continuous electric test. Hear what he says. He states that this "block after 30 days' hardening was put into salt water and its rods connected with the mains of a direct-current dynamo at 125 volts. Since November 8, 1911, it has been under this pressure continuously and shows no sign of current flow nor injury. Without "Starex" similar blocks rise in temperature at once and crack around the positive rod in two days."

In conclusion, we may, I think, say that the big concrete ship is a decided possibility. There is good, solid testimony to the effect that reinforced concrete may be made absolutely watertight, and by more than one method. The objections which relate to other things are of minor importance and are more or less offset by special advantages.

Recent press reports state that the *Faith* has made a successful voyage to Seattle and is now on her return trip. The same news item is mainly occupied with the notice of the Government's contracts which have just been made for 40 big reinforced concrete ships, each of 7,500 tons.

* A variety of volcanic tufa found on the banks of the lower Rhine.
† A transatlantic synonym for reinforced concrete.
†† An error was made in citing this reference in MARINE ENGINEERING, February, 1918, page 62. The page number should be 915 and not "615."

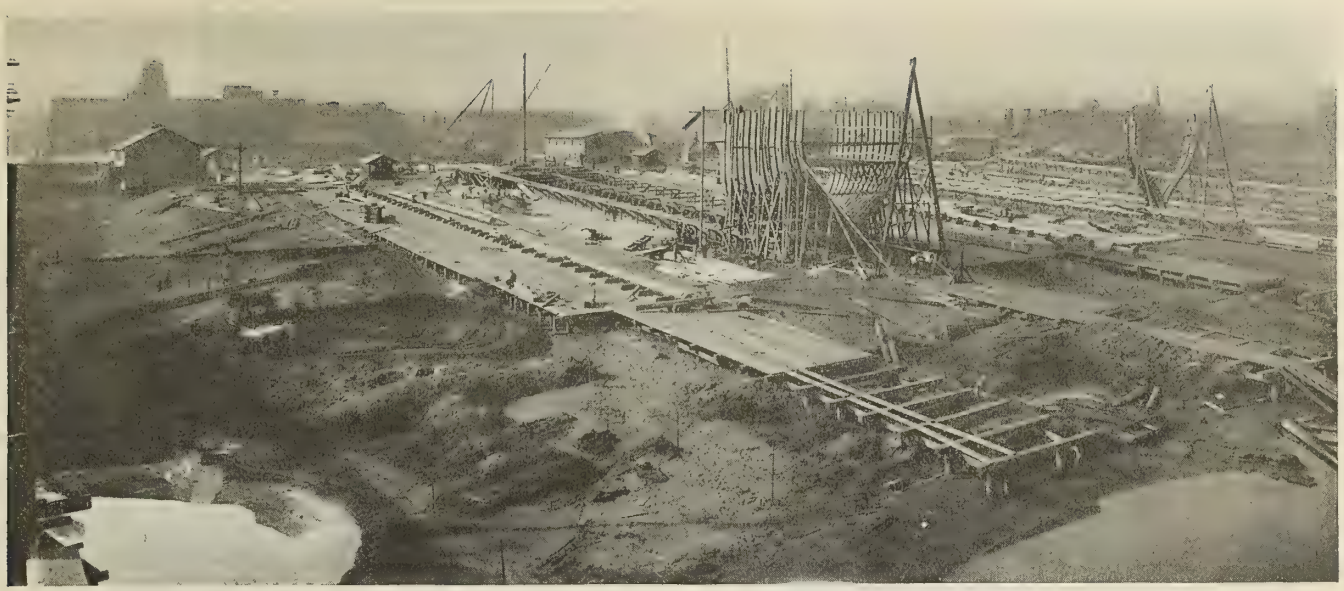


Fig. 1.—View of Foundation Yard at Portland on November 2. Construction of Vessels Begun Before Yard Was Completed

The Foundation Company—Shipbuilders

Newcomer in Shipbuilding Industry Within a Year Is Building Ninety-eight Vessels on Atlantic, Pacific and Gulf Coasts and Great Lakes

NO better example can be found of the astounding growth of the shipbuilding industry in the United States than the development of the shipbuilding facilities of The Foundation Company, of New York.

One year ago this company was equipping its first shipyard for the construction of ten wooden steamers for the United States Shipping Board. It is now operating yards on the Pacific Coast, the Atlantic Coast, the Gulf, and the Great Lakes, and has under contract a total of ninety-eight steel and wooden ships for the Governments of the United States, Great Britain and France. Nineteen of these ships have already been launched and others are following at the rate of ten a month.

Although, at first thought, there would seem to be little connection between the sinking of pneumatic caissons for deep foundations—for which the company has established a national reputation—and the building of ships, it was the organization of ship carpenters and calkers maintained for constructing wooden caissons which gave the company the nucleus of its first shipbuilding forces.

In April, 1917, Franklin Remington, president of The Foundation Company, was called to Washington to consult with the officials of the Emergency Fleet Corporation upon the possible building of wooden ships by engineering and construction companies. As a result of this meeting, The Foundation Company was authorized to equip

Fig. 2.—View of Portland Yard Two Weeks Later, Showing Vessels in Frame

Fig. 3.—Waterfront of Portland Yard, Showing Vessels Under Construction on All Ten Ways

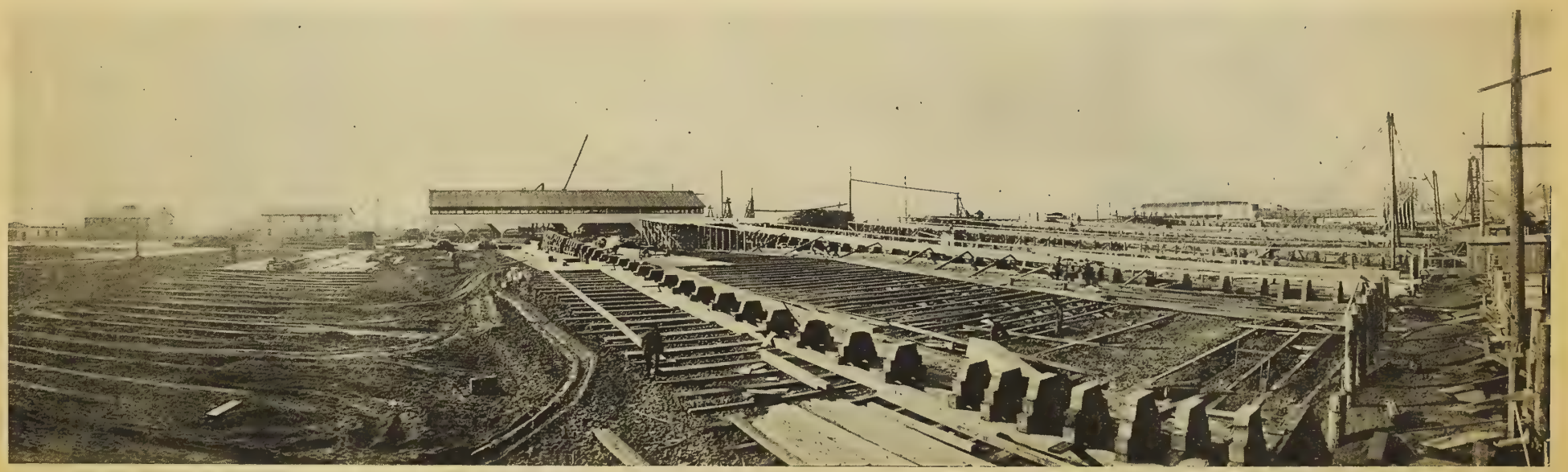


Fig. 4.—View of Tacoma Yard on November 13

THE FOUNDATION COMPANY (NEW YORK)—SHIPBUILDERS

Builders of Steel and Wooden Vessels for Great Britain, France and the United States

Fig. 5.—Fitting Out Yard at Tacoma, Wash. Wooden Auxiliary Schooners Under Construction for France

Fig. 6.—General View of Foundation Company's Yard at Portland, Ore.

a shipbuilding yard for the Government. Property on the Passaic River, near Newark, N. J., was immediately acquired and ten ways were laid down. Although the location of this yard within the metropolitan district of New York placed it at a disadvantage, because of traffic congestion, The Foundation Company was the first of twenty-three competing yards on the Atlantic and Gulf Coasts to launch a wooden ship for the Emergency Fleet Corporation.

This 3,500-ton cargo steamer, the *Coyote* (Fig. 15), has since been delivered to the Government and is being equipped with boilers and engines at the yards of the Lord Construction Company, Providence, R. I. The third and fourth ships from this yard were successfully launched on June 25.

Contract With British Imperial Munitions Board

The second contract entered into by The Foundation Company was with the British Imperial Munitions Board, for the construction of five 2,800-ton wooden cargo steamer hulls. A site for a shipyard was selected at Victoria, B. C., and four ways were laid down. Sufficient property was purchased, however, to permit of the addition of seven ways to provide for increased output. The first keel was laid on July 27, 1917, and the first hull launched on December 27.

This was the first of a fleet of 2,800-ton wooden cargo steamers contracted for by the Imperial Munitions Board with a number of shipbuilding companies on the Pacific Coast. Although The Foundation Company received its contract at the same time as the other yards, and entered the race with a handicap of several months while the Victoria site was being equipped, it launched the *War Songhee* (Fig. 7) a month ahead of its nearest competitor.

In July, 1917, The Foundation Company obtained from the French Government a contract for the construction of forty 3,000-ton wooden auxiliary schooners. It was agreed that the last of the forty vessels would be delivered in December, 1918, which called for a fast building schedule.

Vessels for French Government

The Foundation Company decided to build two additional ten-way yards for the construction of these ships, and naturally turned toward the Pacific Coast because of the abundance of heavy timber available and of favorable labor conditions. Representatives were immediately sent to Portland, Oregon, and, after making a survey of a number of possible locations, they selected a site for one of the two yards on the Willamette River, in the heart

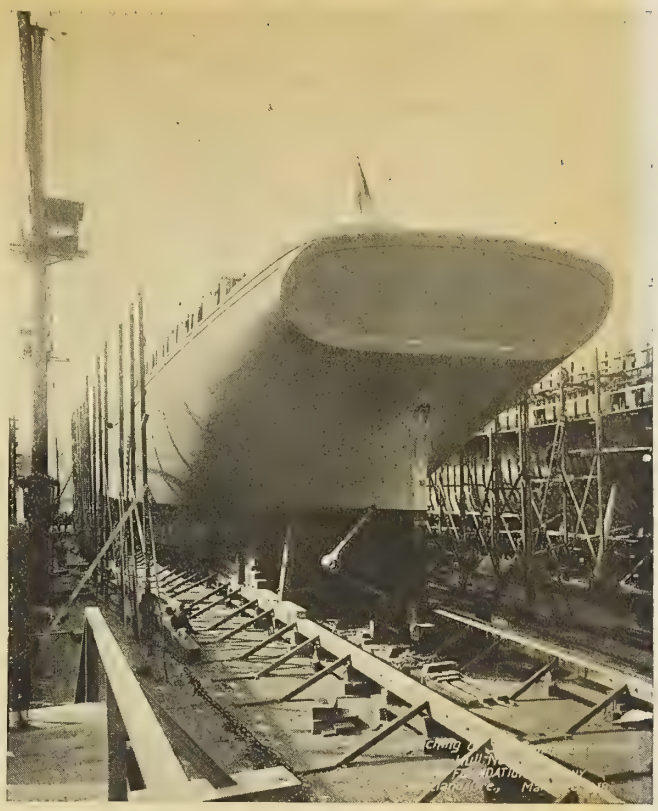


Fig. 8.—S. S. *Commandant Rosin* Ready for Launching at Portland Yard on March 20

of the city. The property has a water frontage of approximately 1,000 feet and adjoins two of the largest lumber mills in Portland. Within three days a preliminary layout had been made and progress schedule prepared. The grading of the yard required a hydraulic fill of approximately four hundred thousand cubic yards.

While this development was under way at Portland, a site for the other ten-way yard was located on the tidal flats northeast of Tacoma. Although this is within the Puget Sound territory, it is far enough away from Portland to prevent both yards from being affected by any labor troubles which might arise. The property selected had the advantage of fronting on two parallel water ways, but it required a large amount of fill, as the ground was under six feet of water at high tide.

The building ways were laid out facing east along the Hylabos waterway, with a spacing of seventy-eight feet on centers and a slope of three-quarters inch to the foot.

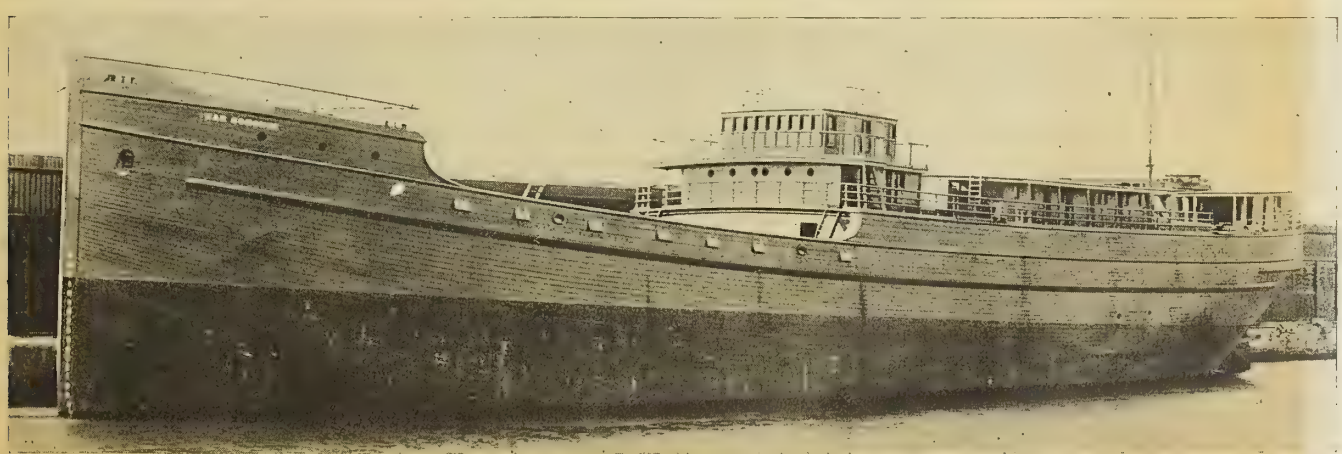


Fig. 7.—S. S. *War Songhee*, the First of a Fleet of Wooden Cargo Steamers Building by the Foundation Company for the Imperial Munitions Board

They are served by ten gantry cranes, guyed to each other and anchored to concrete deadmen.

Each mast is one hundred feet high, with a diameter of thirty-six inches at the butt and twenty-four inches at the head. It is pivoted top and bottom by means of ordinary gudgeons and carries a boom eighty feet long, at an elevation of sixty feet above the ground. At the intersection of the boom and mast, a cage is located, giving the operator a complete view of the hulls under his rig. This system was adopted only after careful consideration of the various methods of handling materials for shipbuilding. Experience has shown that the rigs are adequate for the work and are thoroughly satisfactory in their operation.

Deliveries of rough lumber are made to the Tacoma yard by both rail and water. Water deliveries are handled by stiff leg derricks from the scows to a power feed roll way leading to two Stetson-Ross timber sizers, which handle all planing for the yard. From the sizers the timber is transferred by distributing rolls to an aerial tramway serving a storage yard 60 feet by 800 feet, with a capacity of ten million feet B. M.

At Portland the lumber mills furnish ship timber already planed, so that deliveries are made to the yard by motor truck. Yard derricks handle it directly from the trucks to the storage piles.

Arrangement of Pacific Yards

The layout of both the Portland and the Tacoma yards, which are similar, was the subject of careful study (see Figs. 5 and 6). In the center is a mill building, 500 feet by 200 feet, on the lower floor of which the following equipment is installed:

Five Fay & Egan band saws; 1 American 34-inch band saw; 2 American band rip saws; 1 Greenlee railway cut-off saw; 1 54-inch cut off saw.

Each of these saws is driven by a twenty-five horsepower electric motor.

On the upper floor of the mill building are the mold loft and the joiner shop, the latter equipped with the following machines:

One American 36-inch band saw; 1 American Variety saw, No. 10; 1 Hobbs pony planer; 1 Invincible buzz planer; 1 No. 2 American power chisel; 1 No. 3 American double spindle shaper; 1 wood lathe; 1 Pryibil swing saw; 1 American tennoning machine; 1 20 horsepower motor; 2 7½ -horsepower motors.

Adjoining the mill building is a two-story air tool house, 50 feet by 100 feet. The lower floor is devoted entirely to the storage of air tools, and the upper floor is equipped with saw filing and setting machines.

A wash room and locker building completes the group in the center of the yard.

The main office of the yard is in a two-story executive building, near the entrance, and there are a number of smaller offices scattered about the yard for the superintendents of different branches of the work. Near the main office a small building has been set apart for use as a hospital.

The riggers at each yard are given quarters where they can lay out their work on the second floor of a building known as the "sail loft." The lower floor of this building is used by the pipe fitters and painters.

There are also a fully equipped machine shop and blacksmith shop, where all repair work necessary to the yard equipment is done, as well as mechanical work connected with fitting up the ships.

Among the smaller buildings in the yards are:

(1) copper and tinsmith shop; (2) pipe bending shop; (3) boiler house; (4) air compressor house; (5) punch and shear machine sheds; (6) Stetson-Ross planing machine sheds; (7) treenail shed and kiln; (8) strapping and bolting building; (9) storage shed for finished lumber; (10) 10 derrick hoist houses.

The foregoing description has applied in a general way to both yards, as the buildings in the Portland yard practically duplicate the hull yard at Tacoma. There are several additional buildings in the Tacoma fitting out yard, however, including a storage warehouse 50 by 100 feet and an exceptionally large spar shop.

As protection against fire, a high pressure pipe line has been laid out with numerous hydrants, supplied by motor-driven pumps. The fire marshal at each yard has a crew of trained men. The completeness of the system has caused the Insurance Bureau to give the Tacoma yard the lowest rating of any wooden shipbuilding plant on the Pacific Coast.

Even before the equipment of the yards had been completed, construction of the ships themselves was progressing rapidly, as evidenced by the photographs reproduced in Figs. 1-4. The panoramas of the Portland yard were taken at an interval of twelve days and those of the Tacoma yard at an interval of twenty-four days. Of the forty 3,000-ton wooden auxiliary schooners building at these yards for the French Government, fourteen have been launched and two have already completed successful trial trips. One of these vessels is shown in Fig. 16.

On April 30 a notable record was made at the Portland yard, where the keel of a 3,000-ton ship was laid eleven seconds after the launching of a hull from the same ways. This was accomplished by assembling the keel at one side of the blocks under the hull to be launched and moving it over into position as soon as the ways were cleared. Photographs (see Figs. 9 and 10) taken at the time show that before the spray raised by the launching had settled, the new keel had been trued up on the blocks.

The Foundation Company's Yard No. 5, at Savannah, Ga., was laid out for the construction of thirty-eight 150-foot steel mine sweepers, for one of the Allied Governments. According to schedule, keels were laid on May 20, and the company expects to deliver the first complete vessel in September. Provision has been made for adapting this yard to the construction of 10,000-ton steel steamers as soon as the present contract has been filled.

The Foundation Company has two additional steel shipyards, one at New Orleans, La., and the other at Port Huron, Michigan. The former is now being equipped to build five 4,250-ton cargo steamers of a new "unsinkable" type for one of the allied governments. The yard at Port Huron will construct ocean-going tugs, and steamers up to 3,000 tons deadweight.

Yard No. 6, at Brunswick, Georgia, has been located close to the Southern pine belt. The Foundation Company is building at this yard eight deck barges for the United States Navy, and two wooden ships for private interests.

At present The Foundation Company is employing in its shipbuilding department more than 9,000 men. Very little labor trouble has been experienced—on the contrary the men take great pride in the records which they have established for rapid and workman-like construction.

The Foundation Company was organized in 1902 by Franklin Remington and his associates, under the laws of the State of New York. Mr. Remington has been president of the company from the start, and, in 1914, John W. Doty was appointed general manager.

C. A. D. Bayley is vice-president, in charge of ship construction, assisted by O. F. Swenson, and C. I. Nielsen, naval architects, and by W. I. Bishop and Bayly Hopkins, managers of the shipyards on the Atlantic and Pacific Coasts, respectively.

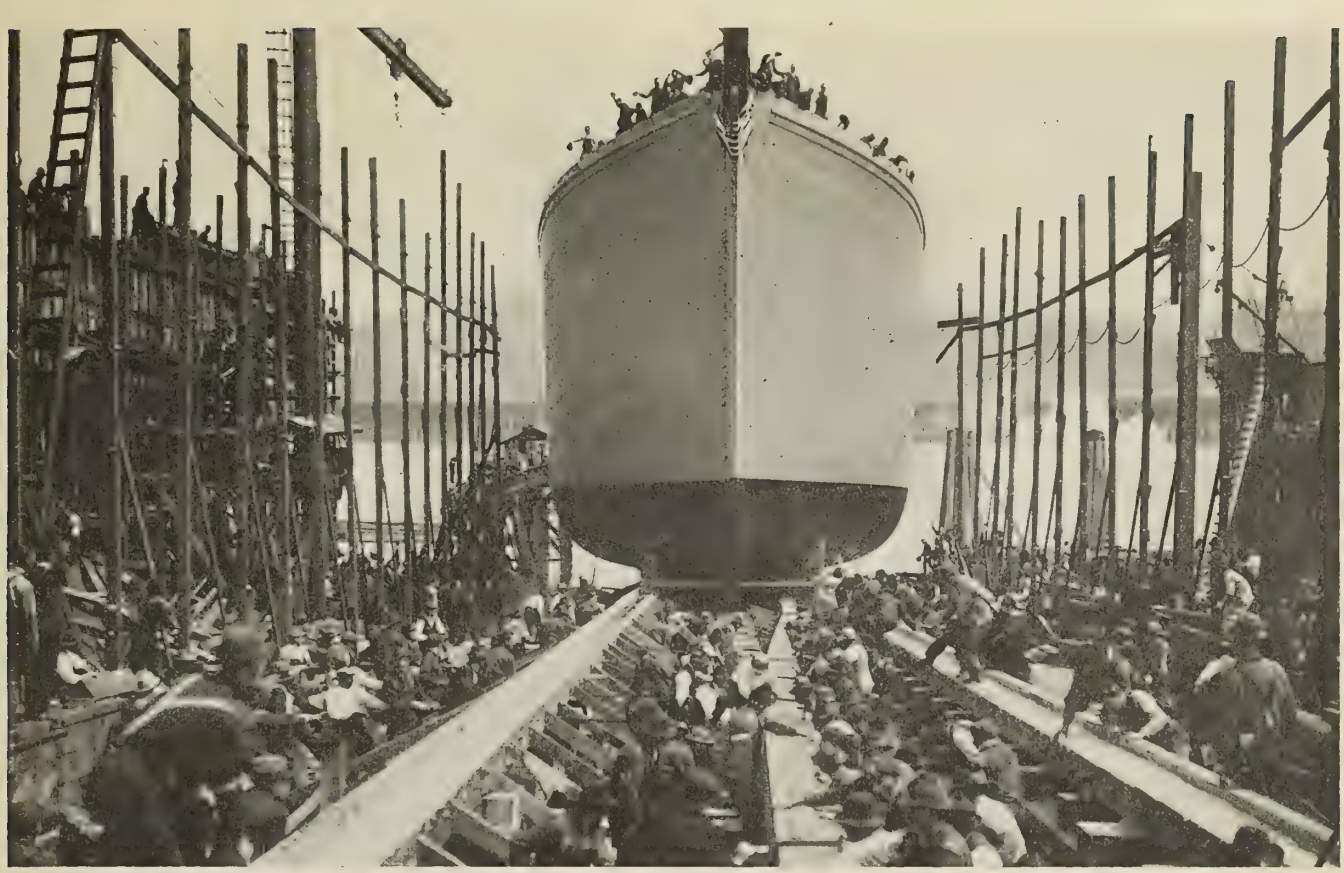


Fig. 9.—Launching of S. S. *Commandant Challes* at Portland Yard on April 30. New Keel Being Laid While the Vessel is Going Down the Ways

Fig. 10.—Keel Laid and Trued Up in Eleven Seconds After Launching Vessel from Same Ways

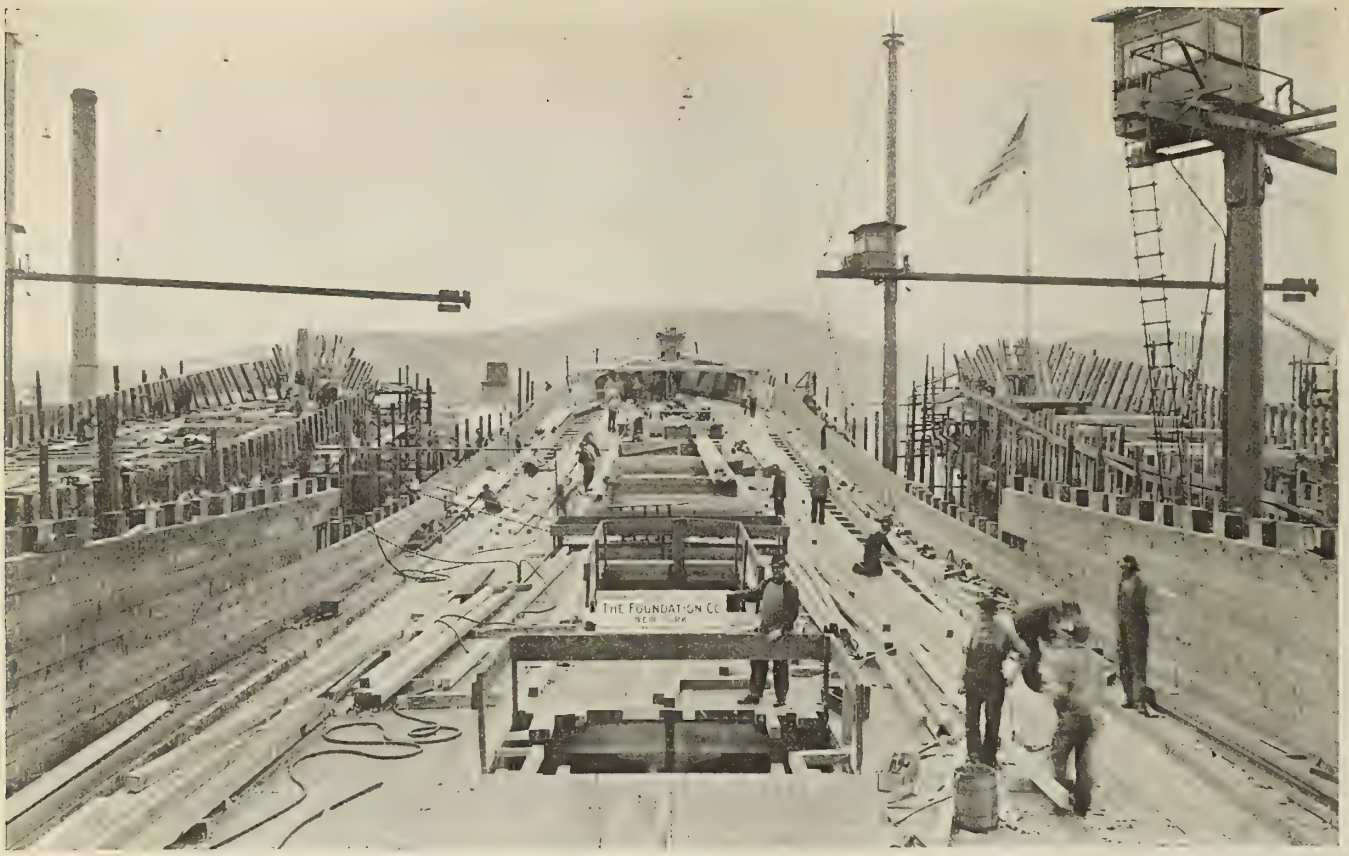
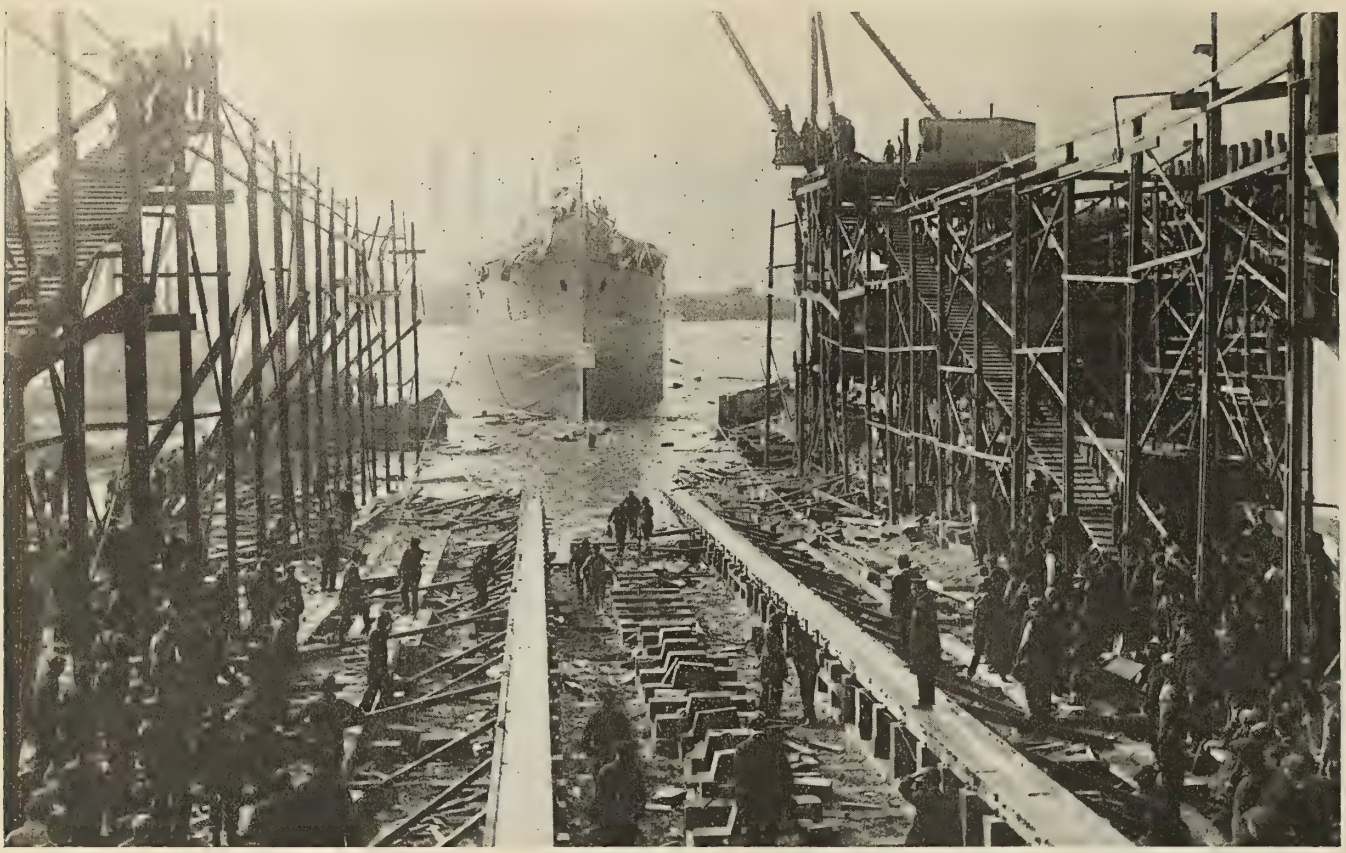


Fig. 11.—Progress of Work on French Ships at Portland Yard on May 16

Fig. 12.—Launching French Auxiliary Schooner *Lieutenant Granier* at Portland on May 11

Fig. 13.—Five Vessels at Fitting Out Berth of Foundation Company's Portland Yard on May 29

Fig. 14.—Section of Fitting Out Yard at Portland



(*Photograph by Underwood & Underwood, New York*)

Fig. 15.—Launching of the *Coyote* at Passaic River (N. J.) Yard of Foundation Company on March 19. The *Coyote* was the first Ferris Type of Wooden Ship to be Launched on the Atlantic Coast

Fig. 16.—The French Auxiliary Schooner *Gerberviller* Starting on Her Trial Trip from Tacoma on June 1

Piping Arrangements Aboard Ship

BY ARTHUR H. BAKER

A SHIP'S piping system may be divided into two classes, and two separate working drawings should be made, showing each system independently. These are classified as follows:

1. Steam and exhaust piping.
2. Suction and discharge piping.

The steam and exhaust should indicate all such pipe lines to the main engines and to all auxiliary machinery, such as the auxiliary condenser, main and auxiliary feed pumps, circulating pump, fire and bilge pumps, evaporating and distilling plant, sea chests, heating system and any other auxiliary machinery necessary for the operation of the ship.

On cargo ships and transports having a direct route the auxiliary units are quite limited, while on naval vessels steaming to all quarters of the globe it is very advisable for installing additional units, as the evaporating and refrigerating plants, also additional pumps cross-connected in a manner that they may be used independently for pumping fresh or salt water to any desired location aboard ship.

Steam pipes are made of copper, wrought iron or steel. Small size copper piping is seamless drawn, while the larger sizes are made of sheet copper with brazed joints. Wrought iron pipes are lap welded, and steel pipes are made seamless drawn or solid drawn.

Copper piping is advantageous in many respects. It is bent very easily to almost any shape and worked into irregular forms as tees, elbows, etc.

While copper pipes are non-corrosive, yet they have the disadvantages of greater cost, low tensile strength and possible deterioration of the material in working to shape and loss of ductility from service.

Steel pipes are the reverse—purchased at low cost, greater tensile strength, and less likely to loss of strength in service.

Exhaust pipes are usually of copper, or brass screwed pipe.

The following formula is adopted for finding the thickness of copper and steel pipes:

$$\frac{P \times d}{8{,}000} + \frac{1}{16} \text{ inch for copper pipes}$$

and

$$\frac{P \times d}{10{,}000} + \frac{1}{16} \text{ inch for steel pipes.}$$

This applies to straight pipe only; the radius for bends should be not less than twice the diameter of the pipe, with thickness figured accordingly.

The main steam pipe leads from the boilers to the main engines (at boiler pressure), while the auxiliary steam piping leads from the boilers to all auxiliary machinery. The steam in this leaves at boiler pressure and by means of reducing valves is reduced to any pressure desired for running each auxiliary.

The exhaust piping from the main engine leads directly to the condenser or by means of suitable valves, cross-connected to the auxiliary condenser. As a general rule the exhaust from the auxiliaries leads through one common pipe to the auxiliary condenser, though in some cases it may be also cross-connected to the main condenser.

Sea water is forced through the condenser by the circulating pump, thus cooling and condensing the exhaust steam, which in turn the air pump delivers to the ship's feed tanks or back again to the boiler. It is very desirable to install a grease extractor on the feed line to the boiler, thereby removing any oil or grease that may have been collected in passing through the engines or condenser.

The suction and discharge pipes convey the water system of the ship and may be classed as follows:

1. Feed water from tanks to boilers.
2. Fire and bilge suction from sea to discharge on deck or overboard.
3. Circulating water, suction from sea through condenser, discharges overboard.
4. Fresh water system, from distillers to ship's fresh water tank or to the feed tanks.
5. All drains from traps, etc., to bilges or tanks.
6. Sanitary system for pumping salt water through ship's head.
7. Circulating water for distillers, suction from sea, through distillers, and discharging overboard or cross-connecting with the fire and bilge pump and discharging on deck, to be used throughout the ship in case of fire.

The above is a general description of the auxiliary piping arrangements. In the following we shall endeavor to classify and describe each system independently.

Evaporating and Distilling Plant

This system is used for obtaining fresh water for drinking and cooking purposes, also to make up for loss of water due to leakage. It is also used as a reserve supply to the feed tanks and boilers.

Sea water is steam-heated until converted into vapor and led to the distiller, where, coming in contact with cold circulating water, it is condensed, thus becoming fresh water. It is then discharged to the gravity tank, scuttlebutt or elsewhere as desired.

The evaporator is a cylindrical shell containing a nest of tubes. Steam passes through the tubes, while the water outside becomes heated and leads to the distiller, where, coming in contact with cold water, it is condensed and discharged and led to the trap and from here to the tanks.

The steam pressure on evaporator shells is figured at 50 pounds.

In a double effect evaporating system the vapor from one evaporator is used for heating the sea water in the other and is then discharged to the distiller; this is installed where two evaporators are used for the sake of economy.

The distillers should be located on the bulkhead or engine room hatch, as high above the evaporator as possible, thus preventing any salt to be carried up through the system with the vapor and getting salt water for the gravity tank.

The salt usually crystallizes in the bottom of the evaporator or on the tubes, and these should be scaled and thoroughly cleaned every week if possible.

(*To be continued.*)

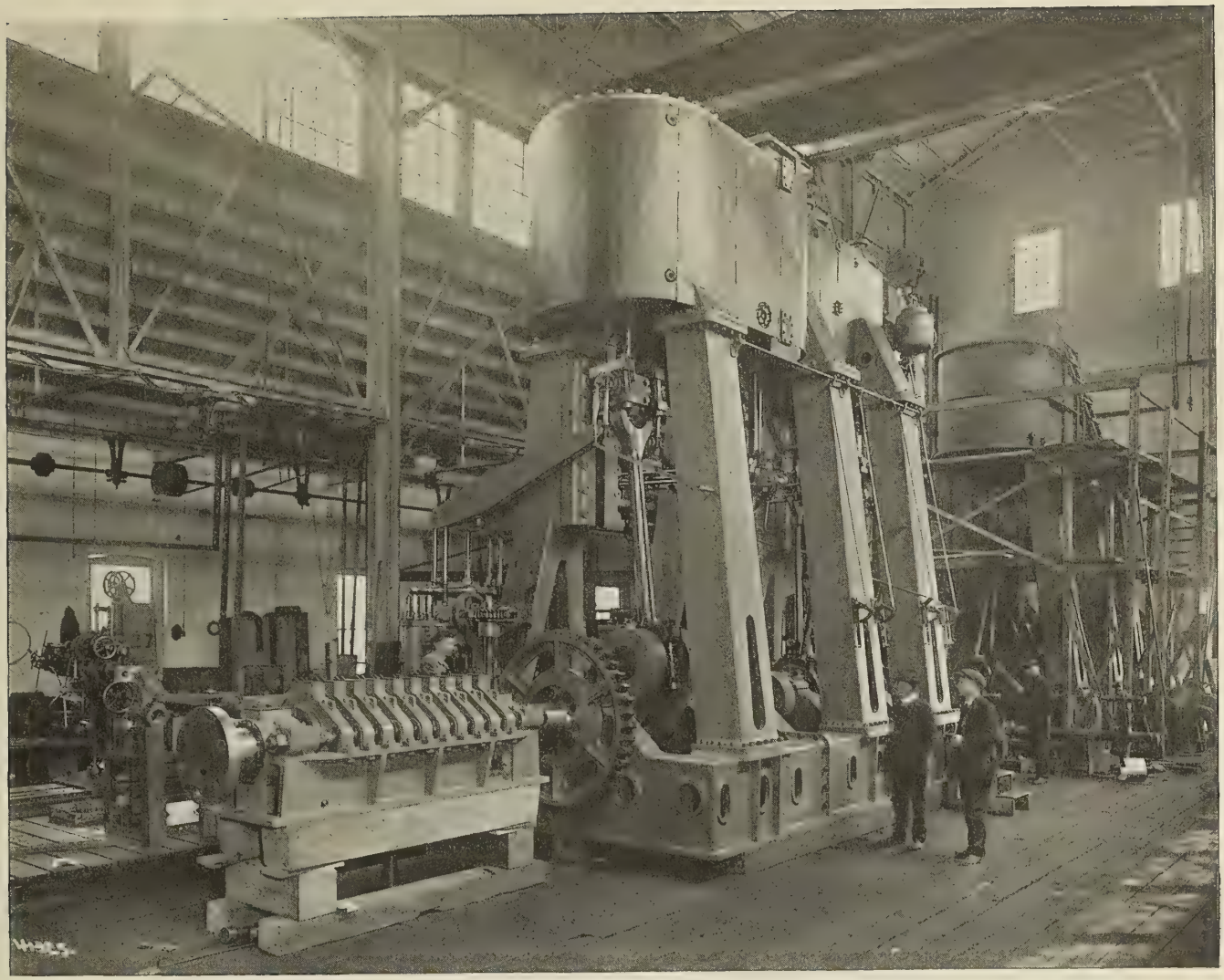
Everybody has seen the punch used in lacing belting. It seems strange that this idea has not been carried out on a larger scale by someone for cutting out holes in packing for studs and bolts.

Metal lagging on valve chests and cylinders will last much longer if given a coat or two of paint on the inside; it never rusts.

The smoother the surface of metal the less is the radiation of heat; that is why it is well to polish the pistons.

(*Photograph by Edwin Levick, N. Y.*)

Fig. 1.—Interior of Machine Shop, Showing Work on Engines, Propellers and Shafting



(Photograph by Edwin Levick, N. Y.)

Fig. 2.—Type of Reciprocating Engine Building for Vessels of the Emergency Fleet

Production of Propelling and Auxiliary Machinery for Emergency Fleet Must Be Speeded Up

DIRECTOR-GENERAL Charles M. Schwab of the Emergency Fleet Corporation has repeatedly emphasized the necessity for speeding up the production of propelling and auxiliary machinery for the Emergency Fleet. In an address before the annual convention of the American Boiler Manufacturers' Association in Philadelphia, on June 18, he stated that eighty or ninety hulls are now in the water waiting for their machinery equipment. The only true measure of the success of the shipbuilding programme is the number of ships completed and placed in service. So far the shipbuilders have achieved marked success in the construction of hulls. The shipyards are rapidly reaching a point where the production of ships' hulls is maintained at a satisfactory point. Due to the better distribution of material and the increased supply of plates and shapes, the hull work is rapidly outstripping the production of engines, boilers and other machinery.

Under the direction of Mr. Schwab the Emergency Fleet Corporation is definitely committed to the policy of extending existing facilities for ship production, and this means not merely the building of new ways for hull construction, but more especially the provision of additional facilities for building engines, boilers and all the accessories which are necessary for placing the vessels in active service. With additional facilities for this work it will be possible to get more ships per way in the existing yards, to say nothing of the correspondingly increased output from the new yards.

According to Mr. Schwab there is a fair outlook for boilers but the facilities for producing engines will have to be enlarged, especially for turbines and auxiliary equipment. Some idea of the immensity of this requirement can be gained from the accompanying views of a typical marine engine building plant which is now actively engaged in this work.

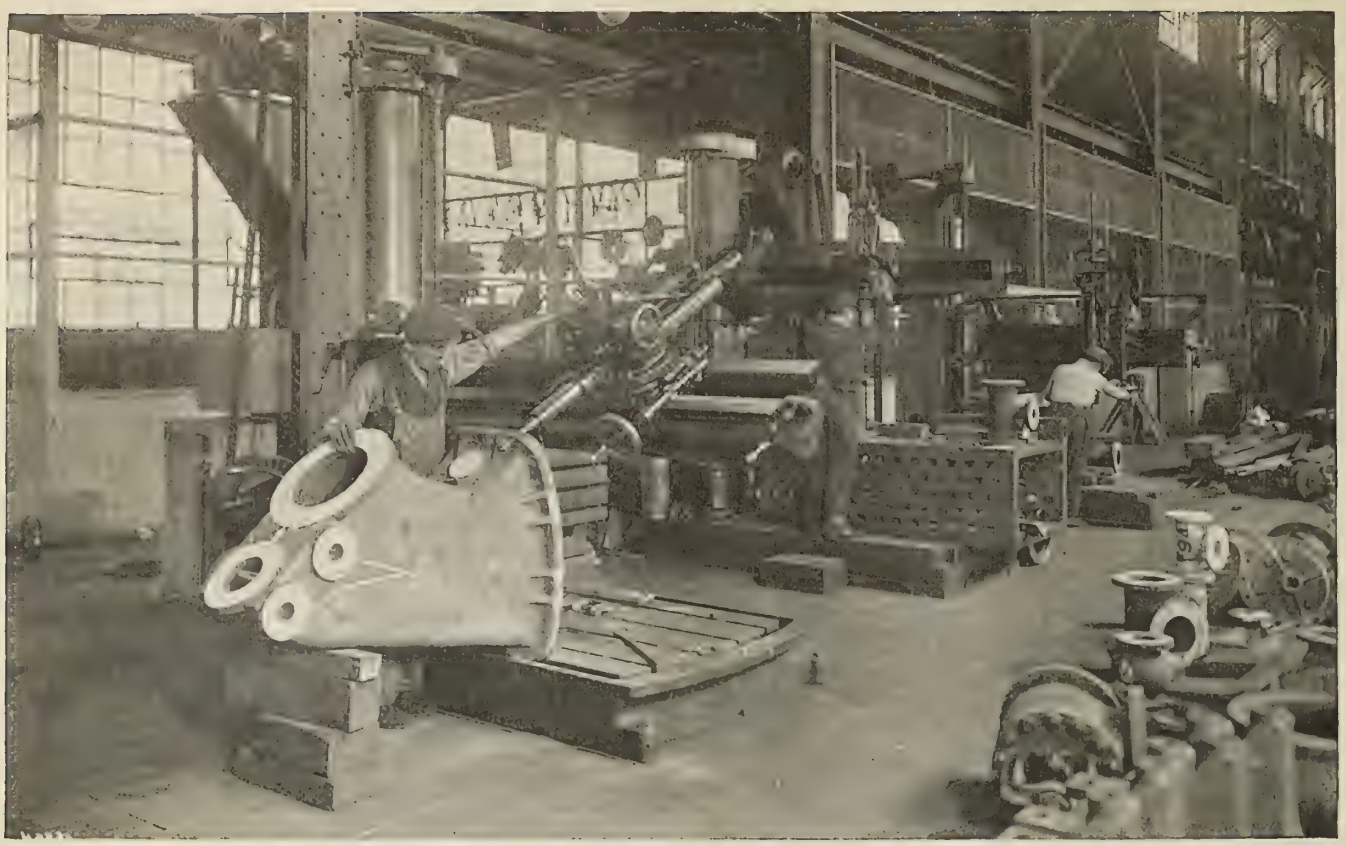


Fig. 3.—Drilling Castings

(*Photograph by Edwin Levick, N. Y.*)

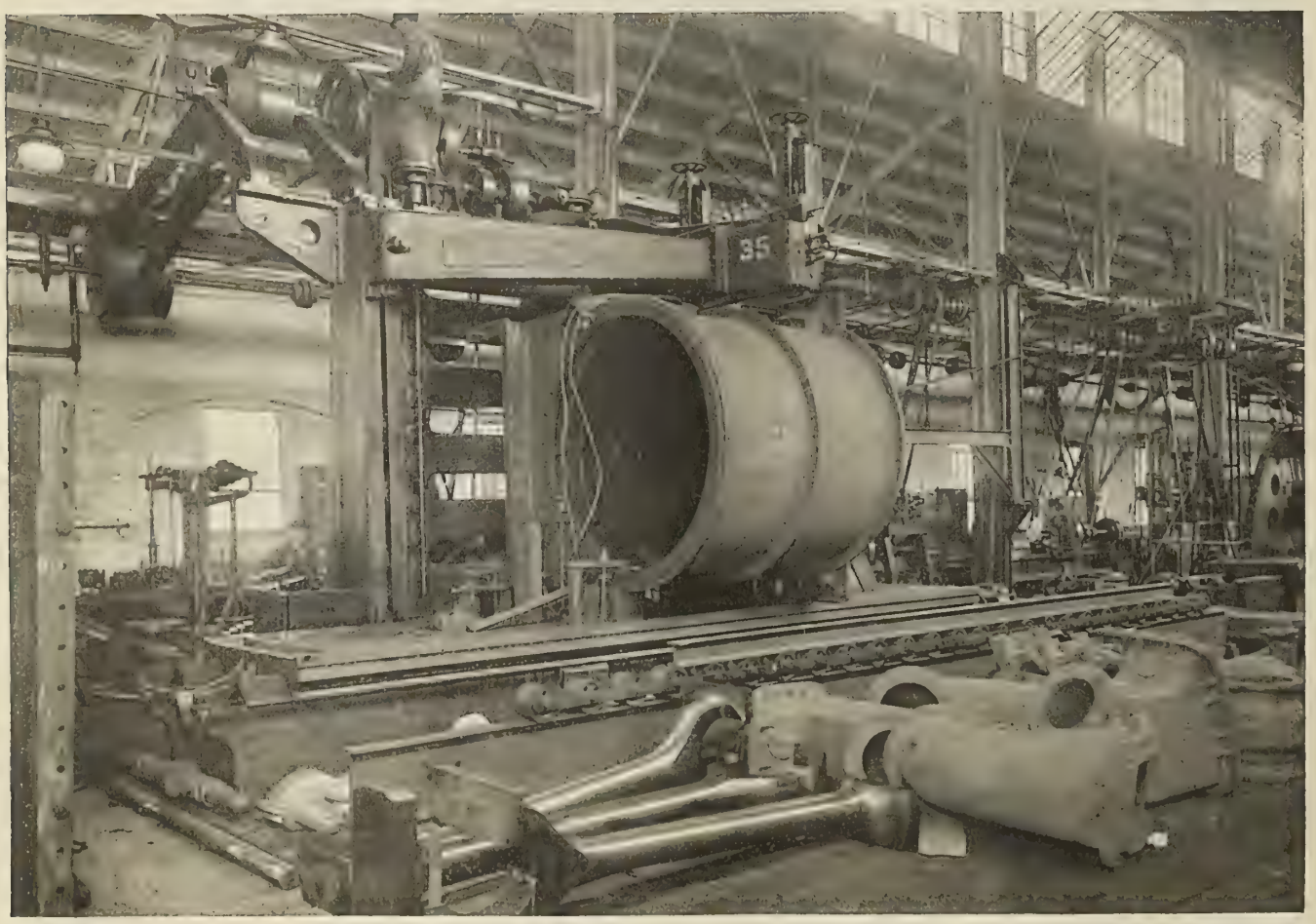
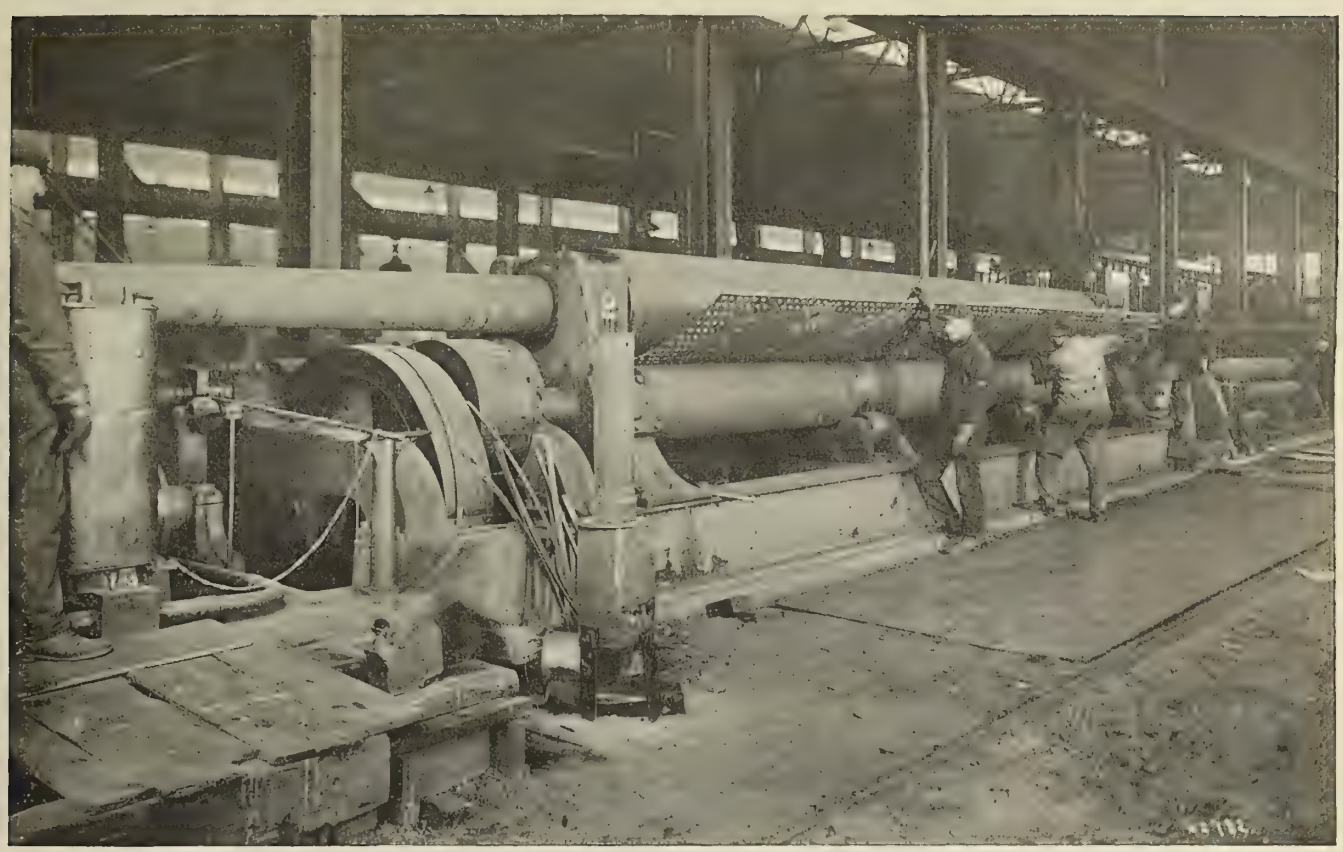


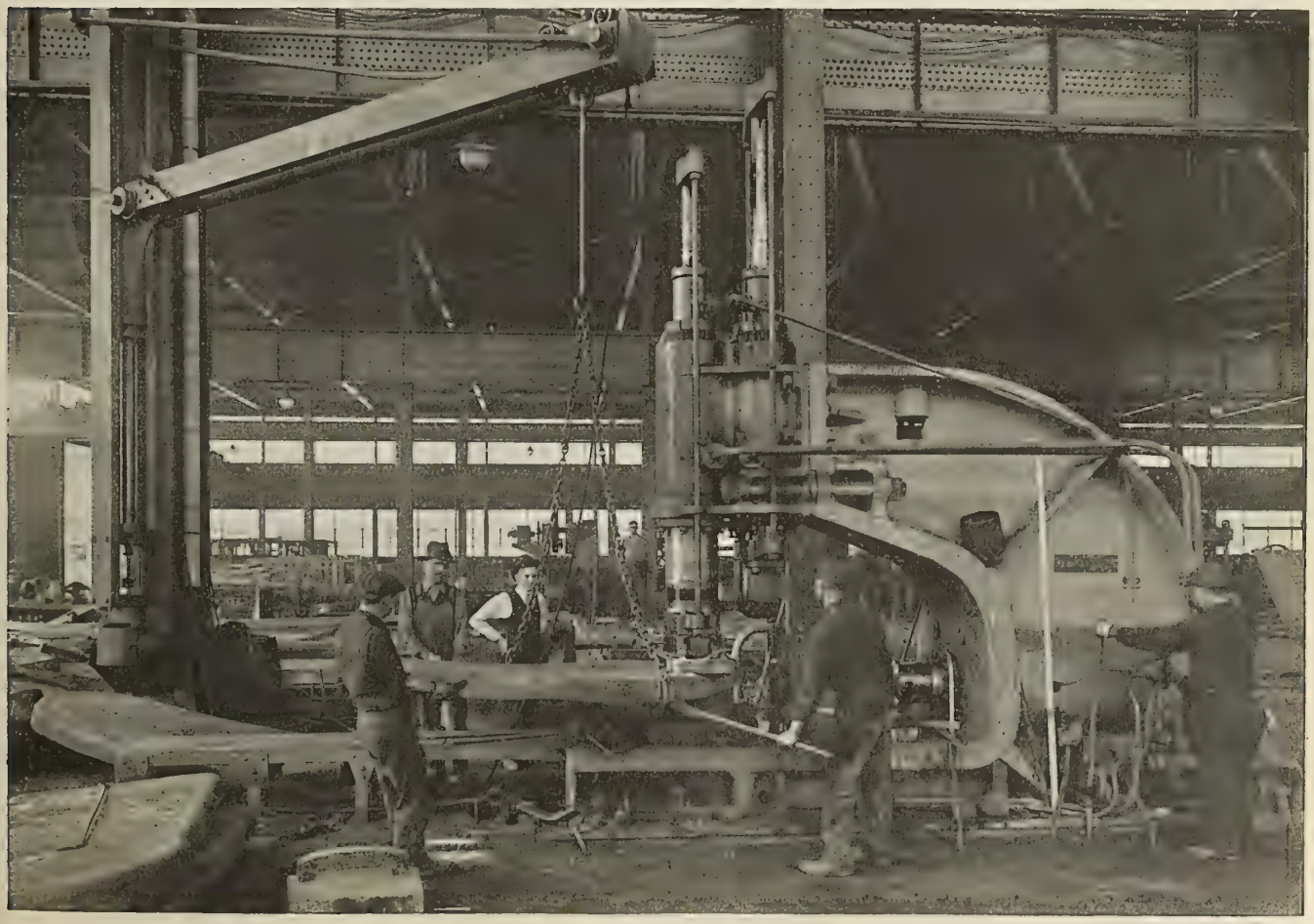
Fig. 4.—Machining Engine Cylinder

(*Photograph by Edwin Levick, N. Y.*)



(*Photograph by Edwin Levick, N. Y.*)

Fig. 5.—Bending Plates After Punching and Shearing Are Completed



(*Photograph by Edwin Levick, N. Y.*)

Fig. 6.—Combustion Chamber Plates Formed on Hydraulic Sectional Flanging Machine

Motor Drive in Structural Steel Shop of Newburgh Shipyard

BY W. H. EASTON*

THE Newburgh shipyard is one of the shipbuilding plants that has been called into being by the war. A year ago its site was a marshland. To-day, on made ground that required thousands of cubic yards of fill, there are numerous buildings, four shipways and four large steel ships already under construction. The launching of the first of the standard 9,000-ton steel cargo vessels, on which this yard will specialize during the war, will take place next August and the other three will follow rapidly thereafter.

Of the various departments the structural steel shop is the one at present in most active operation, though all the others will begin work in the near future. The system of motor drive employed in this shop is of special interest at this time because it is a typical example of an emergency war installation.

Some of the conditions that had to be taken into consideration in laying out this drive were the following: (1) The machinery must be arranged to permit rapid and economical production. (2) The machines are to be handled by more or less unskilled men and hence must be safeguarded as thoroughly as possible. (3) Time is a vital factor; and as deliveries of special apparatus are nowadays very slow, the best possible use must be made of such equipment as can be obtained within a reasonable period of time.

As central station power from the Central Hudson Gas & Electric Company was available, it was of course used, thus avoiding the erection of an isolated plant, saving the labor to run it, eliminating the handling of fuel and ashes, and helping to economize coal. It was also decided to use individual motor drive throughout, in order to insure maximum output from each machine and to provide complete flexibility as to the arrangement of the machines in the shop.

Alternating current only is supplied by the central station; and as practically all the machines in the shop (such as punches, and shears) are of the constant speed type, squirrel cage motors are used almost exclusively. The only exceptions are the furnace blower and the bending

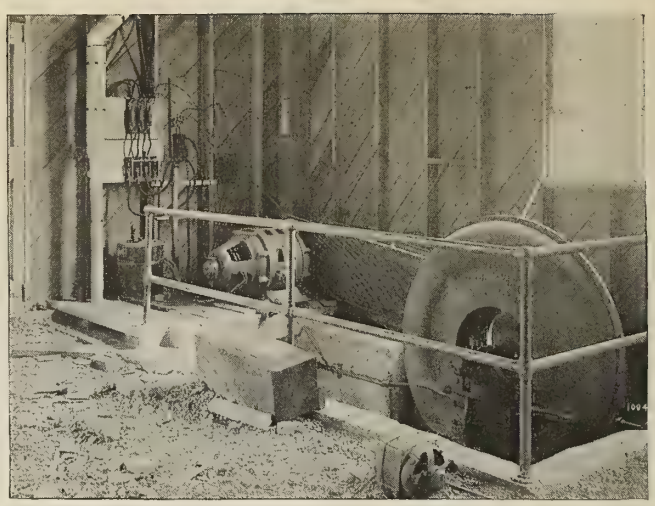


Fig. 2.—50-Horsepower, 870 Revolutions Per Minute Westinghouse Type C.W. Slip Ring Motor, Driving No. 10 Sturtevant Blower for the Crude Oil Plate and Angle Furnaces. Westinghouse Type MF Speed Controller

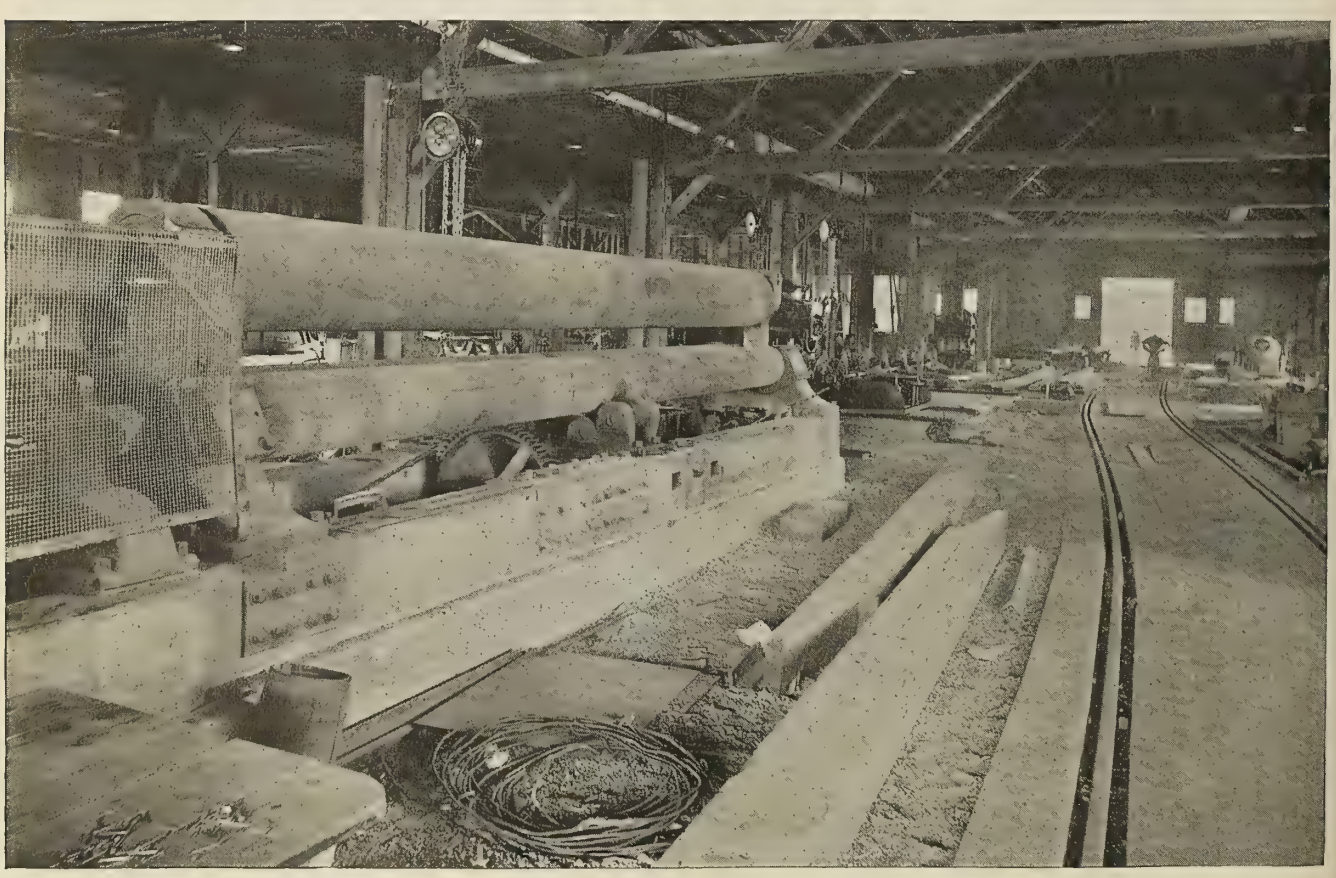


Fig. 1.—General View of Hull Fabricating Shop at Newburgh Yard

* Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa.

Fig. 3.—Motor Drive Installed for Punches and Shears

rolls, both of which require speed variation. The furnace blower, which supplies air for the crude oil plate and angle furnaces, is driven by a slip-ring motor with a drum-type speed controller. The bending rolls were originally driven by a direct current crane type motor, which was supplied with current by a motor generator set; but as this equipment was decidely antiquated (war conditions making it impossible to secure modern apparatus at the time it was wanted), a variable speed alternating current motor is now being installed in its place.

As can be seen from the illustrations all the machines are belt driven. This is not the best possible practice, since, for such a machine as a punch or a shear, engineers usually favor mounting the motor on the machine and driving by means of gears. But this type of drive requires special machine work and a special high starting-torque motor, and would have added months to the delivery date of the equipment. Hence standard motors with belts were used instead.

High starting torque motors would, however, in any

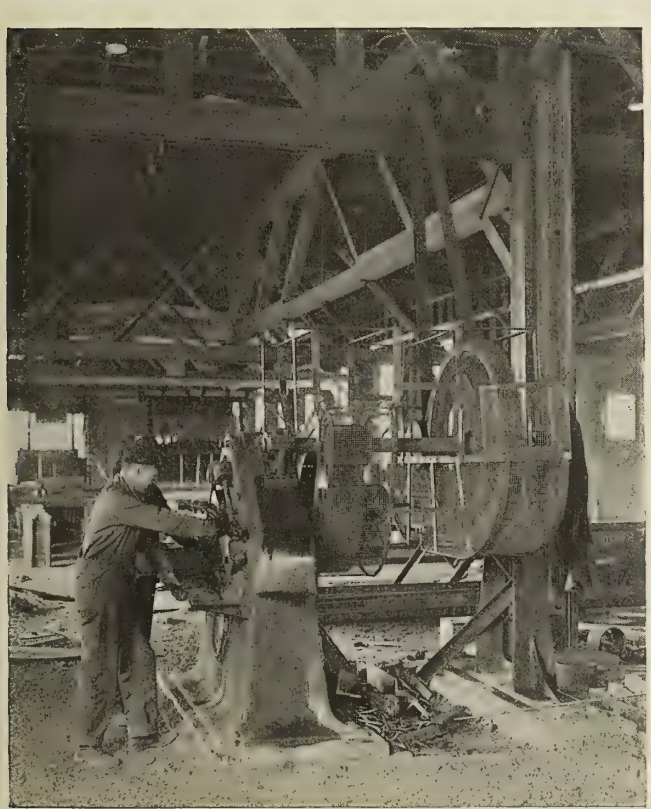


Fig. 4.—5-Horsepower Westinghouse Type CS Squirrel-Cage Motor Driving 6-Inch by 6-Inch by ¾-Inch Hilles & Jones Angle Shears

Fig. 5.—5-Horsepower Westinghouse Type CS Squirrel-Cage Motor Driving Hilles & Jones Horizontal Punch for Punching ⅞-Inch Holes in ⅞-Inch Plates. Westinghouse Type A Auto-Starter

case have been desirable for driving these ponderous machines with their considerable flywheel effect, but it was thought that the belts would slip enough in starting to relieve the motors of the excessive stresses that occur at this time, and experience has proved this to be the case, since none of the motors have given trouble. This good record has been especially gratifying to the engineers in charge of the installation, since time did not permit a power test to be made of each machine and the motors were selected largely by judgment and the supply of motors available for early delivery.

All belts, pulleys, and gears are carefully protected by wire metal screens, and all motors that are started and

Fig. 6.—5-Horsepower Westinghouse Type CS Squirrel-Cage Motor Driving 7/8-Inch by 7/8-Inch by 30-Inch Hilles & Jones Vertical Punch. Westinghouse Type A Auto-Starter

stopped by the steel workers are controlled by means of auto starters or oil switches which have no exposed live parts and cannot be improperly manipulated by even the most careless person. Automatic protection against overloads and failure of power is also provided.

The current from the central station is received at 5,700 volts. A small sub-station in the shipyard, consisting of a bank of transformers and a panel carrying the necessary switches and meters, reduces the voltage to 220 for use around the plant.

A Breakdown Aboard Ship

The following account of a breakdown which happened to the engines of a steamer on which I was chief engineer may be of interest in view of the active interest being taken in marine engineering at the present time.

We left Rotterdam (pre-war days) with a cargo of coal and proceeded down the river, everything running smoothly and well. Shortly after we had dropped the pilot and were heading at full speed for the Straits of Dover, a tremendous bumping caused me to rush to the engine room, where the second engineer already had the engines stopped. It had all happened so suddenly that there was no chance to locate the cause of the trouble, and nothing unusual showed to give us a clue. Being satisfied that something was wrong inside one of the cylinders, we proceeded to open them up. Their dimensions were: High pressure, 25 inches; intermediate, 41 inches; low pressure, 67 inches; stroke, 45 inches. As far as the second engineer could judge, the noise came from the intermediate cylinder, but on opening it we found it in good condition. On opening up the high pressure cylinder, however, we found a sorry mess; the piston was smashed into "a thousand and one" pieces, caused by one of the junk ring bolts breaking at the end of the thread. There being insufficient clearance between the piston and cylinder cover, something had to go, and apparently the piston was the weakest part. Fortunately, after a few strokes the broken bolt got opposite one of the core plugs on top of the piston, and on the next stroke the core plug was forced in and the broken bolt jammed in the hole, thus preventing any further damage.

Running on Two Cylinders

To operate the engines as a triple expansion set was out of the question, so we made ready to run on two cylinders. The pieces of the broken piston were removed, but the piston rod with the crosshead and guide shoes was left in place, the piston rod thus serving to keep the gland steam-tight. With the piston valve and valve gear removed and the covers replaced, we were ready to proceed. The boiler pressure was reduced from 175 to 100 pounds. No trouble was experienced in starting the engines, and we headed for Deal, where we could report the accident to headquarters. Orders were received there to proceed to Plymouth where a new piston would be sent us.

The trip down the English Channel was uneventful though somewhat slow, but the engines gave no trouble, even though they were somewhat out of balance due to the cranks being at 120 degrees. The coal consumption on the "pounds per indicated horsepower" basis was largely increased, but that was to be expected with a reduced initial pressure and the consequent reduction in the number of expansions by the loss of one cylinder. The limits of the valve gear prevented us cutting off early enough in the new high pressure cylinder to give the previous ratio of expansion.

Straightening the Piston Rod

On arriving at Plymouth, the first job was to get the piston rod out to find out whether it had become bent in the smash. The limited means we had on board ship for testing proved that the rod was damaged, so it was sent ashore to a repair shop. When placed in the centers of a lathe, a double bend was found at the tapered part which fitted into the piston. The straightening of the rod, which was 6⅜ inches diameter, proved to be a difficult job, but by means of a charcoal fire, wooden blocks and mallets the blacksmith managed to get it nearly true and comparatively free from marks and scaling. When tested in the lathe again, only a slight cut was required to bring the tapered part true. This allowed the piston to go ⅛ inch farther on the rod, but there was sufficient clearance in the cylinder to allow for this.

Having got the new piston fitted to the rod, no time was lost in having it placed on board, where everything was ready to handle the job with dispatch. It was 2 p. m. when the piston and rod were on deck, but we were ready to sail by 10 p. m. On the voyage out and home again

no defects developed, and so far as I know the same engines are doing duty still.

Some of the things we did, or rather the things we omitted to do, in connection with this job are open to criticism, such as neglecting to close up the steam ports in the high pressure cylinder and not changing the cranks to 90 degrees; but the distance we had to travel to the nearest port was not great, and we were anxious to get under way again in the shortest possible time.—*John Melville, in Power.*

What Women Are Doing in the Shipyards and Shops in Great Britain

In a recent issue of the *London Daily Chronicle,* a correspondent has the following to say regarding the work women are doing in the the shipyards and marine engineering shops in Great Britain:

The tasks women are doing in and about the yards and marine engineering shops are innumerable. That fact tempted an engineer to say two years ago that by 1918 women would be able to build a battleship from keel to aerials. Too optimistic a statement, maybe, but let us consider for a moment what they have actually done.

Work in the Shipyards

I have before me a carefully compiled record of the multifarious jobs being done, and well, by women in and about shipyards and marine engineering shops. Before setting them down I will quote the words of an eminent Scottish shipyard expert: 'Strength and endurance alone prevent women from doing all the jobs. They are intelligent enough—more intelligent than many of the men; they work hard; they don't get 'fed up' with doing the same job constantly. Give them a repetition job that makes good pay and they will go on with it week after week—quite happily. But there are jobs they cannot do: heavy riveting; working up to their knees in water and mud, repairing the keel of a ship, moving ships about the yards, and so on.'

On board ship, women are fitting electrical apparatus for yard lighting, mains and telephones, and doing complex wiring work generally. Also they are chipping, scraping and painting (doing dredgers and steam hoppers externally and internally). In the yards they are hydraulic riveting, scraping and coating the bottoms of destroyers and submarines, driving cranes (some of 50 tons). French polishing, laboring (carrying 60-pound weights singly), loading into wagons and barges, cleaning and painting chain cables.

(Photograph by Press Illustrating Service, Inc., N. Y.)
Women Operating Radial Drills in Drilling Stern Frame

(Photograph by Press Illustrating Service, Inc., N. Y.)
Women Scaling Bottom of Vessel in Dry Dock

In the workshops in or near the yards they make and repair the overalls and 'Fearnought' clothing, make flags and sails and do upholstery. Many had thought that wood-working machinery ran at too high a speed for women, but women are operating machines for wood planing and for making wooden boiler tube plugs.

In the Engineering Shops

The engineering shops find them work on 6-inch and 8-inch slotting machines, horizontal and vertical drilling machines, and turret and capstan lathes (non-repetition work in very many cases and the women setting up their own tools). One woman, said to be able to turn her hand to any job, operates a radial turret drilling machine with capstan head which performs six operations. Overhead cranes are driven by women, and one woman drives a traveling jib crane among the small lathes. They are generally employed on radial and sensitive drills and milling machines, and turbine blades are made and assembled by them. Women are also acetylene welding, nut facing, and acting as plumbers' assistants. In the foundries they are machine molding, core making, grinding, packing, and sorting.

The boiler shops find them work drilling, boring, turnings, slotting, helping light platers, painting, assisting with rivet machines, pickling boiler tubes, cutting tubes, removing burrs from tubes and plugging them, and turning tube expander mandrils. They are fitting and filing pipe and valve flanges, filters and valves, and bending superheater tubes. They are constantly working in the rigging house on wire ropes of 1½ inches, and have done 2 inches. In the braziers' shops they are repairing lamps and soldering.

Of the more readily suitable jobs, such as tracing, storekeeping, time-clerking, scutching and spinning fibre in rope shops, looking after switchboards in generating stations, and lacquering, there are a great number.

All these are not jobs ideally suited to women. That the women are doing them, and, on the whole, well, is sufficient tribute to their fearless adventuring on any task open to them, to their inspiring industry, and to their great and whole-hearted championship of the cause of humanity—the Allied cause.

Oil- and Water-tight Joints in Ships' Hulls

Effective Methods of Securing Water- and Oil-Tight Joints in Ship's Structure Under Different Conditions

By Evers Burtner*

MORE than ever before the ranks of draftsmen are being recruited from technical school graduates, or others who have had little or no practical shop experience. This is a decided handicap both to the men themselves and to the yards in which they may serve. These men should welcome every opportunity to learn the reasons for various practices employed by questioning the leading men of the plant, by careful study of standard treatises on ship construction† and the pertinent articles which have recently appeared in Marine Engineering. My own experience has been that the average leading man or skilled workman is only too glad to give his reasons for the various methods he uses to secure the best results. In the present paper, I aim to give a brief description of some of the more effective ways in which water- and oil-tight joints may be secured under different conditions.

There are three chief methods used in producing watertight joints, viz.: by welding, by calking and by packing or gaskets. Of these, welding, it seems to me, holds much promise for the future, since its general use would relieve us of the trouble of calking and punching. It is well to remember, however, that a welded joint does not have 100 percent efficiency any more than a riveted one. An account of some tests made of oxy-acetylene welds showed that the tensile strength of the joints approached the strength of the remainder of the metal (about four-fifths of the latter), but its ductility was very low. This is due to the fact that the metal at the weld does not receive the same treatment as the rest.

Calked Joints

Calking produces a watertight joint by forcing the edge of one plate hard up against the other. The spring-like property of the calked plate causes the joint to remain watertight, as shown by Fig. 1. Lap calking is more common than butt calking and is preferable from the point of view of tightness and ease of production. The tools used are the splitting edge or maker, the reeding and the butt tool. For a lap joint, the splitting tool would first be employed to cut a groove. This is followed by the edge tool, whose function it is to force the lower edge of the lapped plate against the other. If the groove is about 3/16 inches above the faying surface, and the inspector cannot insert his testing knife, the calking is considered satisfactory until otherwise tested. In a butt joint, after cutting grooves ¼ inch from the ends of the two plates, the butt tool may be used to finish the operation.

The following axioms concerning calked joints should in general be true:

A calked joint ought to form a complete circuit, and therefore no discontinuity in the calking edge should be allowed. An example of this is the bulkhead boundary bar.

As a rule only one side of a watertight or oiltight division is calked, and the more accessible side should be chosen. However, where two adjacent compartments are to be tested, both sides of the bulkhead may be calked so that leaks can be readily "touched up" under test.

Angles or flanged plates bounding a watertight or oiltight compartment should face, if possible, so as to allow calking while the compartment is under test. Flanged plates which are to be calked require special attention, since, of course, only the edge can be so treated.

In three- or four-ply work the watertight thickness preferably should not be the central one.

Stiffeners, when possible, ought to be placed on the non-calked side. If this plan is followed, simply calking the rivet heads will produce watertightness. When for any reason stiffeners are used on the calked side these as well as the rivets may require calking.

To prevent drain water from causing rust streaks it is often necessary to employ watertight rivet pitch and calking in a joint which otherwise might not require this.

Riveting

Rivets are commonly not calked even where the seams are, unless special tightness is required, as in oil tanks. Countersunk rivets can readily be calked, and, therefore, countersunk heads and points should be used where the plating is reasonably thick, and if both sides of the tank should need calking under test. Pan head rivets can be calked, but are to be avoided when possible, wherever the calking of rivets is needful. Because of their hardness, nickel steel rivets are difficult to calk successfully.

Some insurance companies require that oiltight rivets be ¾ inches or more in diameter. Where two plate edges of unequal thicknesses are connected, the thinner plate naturally determines the size of the rivets.

The pitch of the riveting in plates varies from three to four diameters for oiltight joints, and four to five diameters for watertight. Boundary angles and staples may have a slightly greater rivet spacing. In boundary bars, where two rows of rivets are used in each leg, the pitch of rivets next the heel is sometimes made just twice that of those next the toe. Staggered or zigzag riveting is often employed for boundary bars, stiffeners and bracket plates; elsewhere chain riveting is customary. It should be remembered, however, that these rules are not ironclad, and in special cases the pitch of a few stray rivets may be a diameter or so greater when the plating is reasonably thick. The lap of the plate is from one and a half to one and five-eighths the rivet diameter.

Plating

As a rule, 3/16 inches is conceded to be the thinnest plating that can be conveniently calked; any thinner plating is usually made water- or oil-tight by packing or welding. In the best class of work, all plate edges are planed before calking, to make sure that the rough edge left by shearing is removed. Furthermore, the rivets should be punched from the faying surfaces so that there may be no rag left on the edge of the hole to prevent the joint from being bolted up tightly, and also because the hole on the die side of the plate is greater in diameter.

Joggled plating or boundary bars require that a scrap of steel ("Dutchman"), be driven in to produce water-

* Instructor in Naval Architecture, Massachusetts Institute of Technology, Cambridge, Mass.

† Holm's "Practical Shipbuilding."
Hovgaard's "Structural Design of Warships."

or oil-tightness (Fig. 2). A tapered or an ordinary liner for "in and out" plating is a legitimate method of avoiding this.

The relative efficiency of the end connections in plating as regards calking is according to the following order: butt lap, double butt strap, single butt strap.

Butt Laps

Where three plates come together, as at the intersection of a butt lap and an edge seam, the wedge-shaped hole

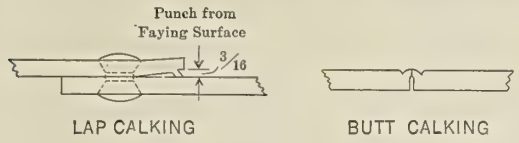


Fig. 1

Fig. 2

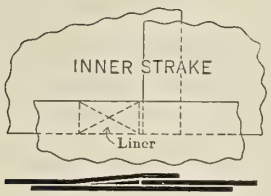


Fig. 3

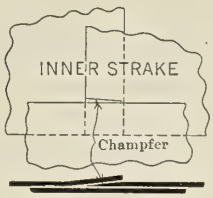


Fig. 5

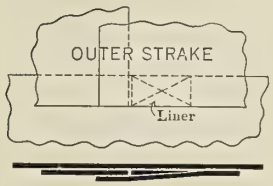


Fig. 4

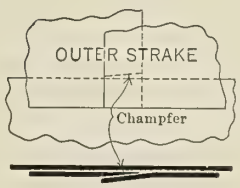


Fig. 6

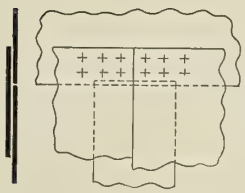


Fig. 7

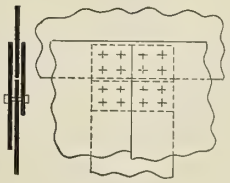


Fig. 8

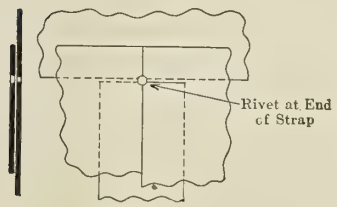


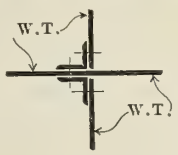
Fig. 9

occurring at such a point must be filled. The ordinary plan is to use a tapered liner, as shown in Figs. 3 and 4. The liner should be long enough to take at least three rivets.

Instead of using a tapered liner the edge of the plate may be chamfered (Figs. 5 and 6). It is sometimes considered best to chamfer the inner strakes and use tapered liners for the outer.

Single Butt Straps

Because of the nice fitting required of plates meeting at the butt joints, and the greater trouble in calking, the use of lap joints is to be preferred. With the increase in the length of shell plates it becomes more difficult to make the edges meet closely enough for satisfactory butt calking. Where the butt straps run the full width of the butted plate, as on the inside strakes of the shell, the calking is not troublesome. But for the outer strakes, where the butt strap is stopped short of the inner plate



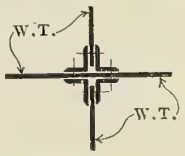


Fig. 11

Fig. 10

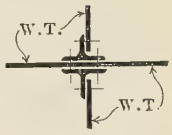


Fig. 12

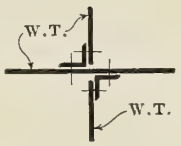


Fig. 14

Fig. 13

edges, any one of the three methods indicated in Figs. 7, 8, 9 may be employed when an absolutely tight joint is required. Fig. 9, no doubt, presents the simplest plan, while Fig. 7 illustrates a method similar to the one employed for the butt straps of boilers and is the most efficient.

Angles

The thickness of the leg of an angle should be 3/16 inches or more, for satisfactory calking. To get rid of the round at the toe, the calking edges are invariably planed or chipped, and this is usually best done before bolting in place. Where it is necessary, the heel of an angle may also be calked, but this is likely to be less efficient and should be avoided whenever possible. If it is considered advisable to calk both sides of an oiltight floor with a single boundary bar, the edge of the plate may be calked against the angle before erection. Bracket plates landing on oiltight bulkheads often have double angles to provide a stronger connection than the single angle affords. A "T" bar from the standpoint of calking is to be preferred. A comparatively thin bulkhead can be made watertight by the use of two boundary bars, one of which may be calked, and the other will prevent the bulkhead from deflecting away from the calking angle. Nevertheless, it should be borne in mind that if the plating springs away from the boundary angle it will hardly be stiff enough at the seams.

Disposition of Angles

Where strength of structure, together with watertightness is necessary, Figs. 10, 11 and 12 illustrate the

customary layouts. Fig. 10 requires less riveting, but is weaker than the other two schemes, and deformation is likely to take place as suggested in the sketch. For oiltight work, Fig. 12 indicates the best plan to be followed, since it has less three-ply riveting. But all of these methods of construction involve three-ply riveting, and therefore packing may be necessary.

If watertightness is of first importance, and strength merely secondary, the scheme in Fig. 13 would better be followed. But under strains this construction is less dependable than the previous ones, as our sketch illustrates.

In passing, we may remark that with non-watertight work, and where strength is fairly important, three-ply riveting, as indicated in Fig. 14, would be preferable to reversing the angles. This would dispense with one row of rivets, and three-ply rivets with careful loft work and punching would not be objectionable.

Staples and Boundary Bars

With channels the stapling is quite complicated. The inexperienced draftsman should remember that it is necessary to cut a rectangular hole in the plating in the way

Fig. 15

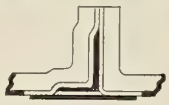


Fig. 16

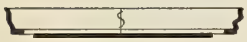


Fig. 17

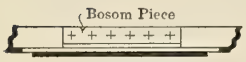


Fig. 18

Fig. 19

of the channel, as in Fig. 15. This calls for welding a piece in the boxed end of the channel to take rivets, as indicated. The difficulty in forging staples has led to the suggestion that they should be standardized, and made of steel castings or machine-forged pieces.

When staples are required around bulb angles, the best practice is to chip away the bulb in order to simplify the smithing. It may be worth while, also, to remove the outstanding flange of a channel in the same manner, if at this point the additional strength it contributes is not greatly needed.

Joints of Boundary Bars

Three possible cases occur in this connection. If watertightness is of primary importance and strength only secondary, we may let the boundary bars merely butt neat and calk the butt. However, if watertightness and strength are both very necessary, a bosom piece, fitted as in Fig. 18, would be employed. Such a piece must be planed on its heel, and usually on the toe also. Where strength is the first consideration, and watertightness is of minor importance, the heel piece (Fig. 19) is best.

Castings

It may be necessary at times to calk castings riveted to the shell or deck. Cast steel of 60,000 pounds per square inch tensile strenth or less can be readily calked. Manganese bronze also will generally admit of the same treatment.

Clearance in the Way of Calking Edge

A single case illustrating the need of sufficient space to calk properly is the postion of the waterway angle, clear of the stringer angle. Bracket plates should be sniped ¾ inches or more clear of the toe of the angles requiring calking, as indicated in Fig. 21. It goes without saying that this rule should be carefully followed. Sometimes this loftsman must call for a countersunk rivet in place of the ordinary pan head when the rivet head interferes with the calking of the seams.

Places Requiring Packing

Packing should be employed where calking alone will not produce watertight or oiltight joint, as for example where a watertight division is pierced by structures, or in three- or four-ply riveting, especially when the center thickness is watertight. The intersection of a frame with a deep tank top may be cited as a familiar example of a watertight division pierced by structure. Since we cannot be sure that the frame bears hard enough against the shell to prevent a leak at this point, we may provide against this danger, either by placing a small piece of packing, as indicated in Fig. 22, or a thread stop-water may be laid along line *A B*, Fig. 23, and the toe and heel calked up to this point.

Fig. 20

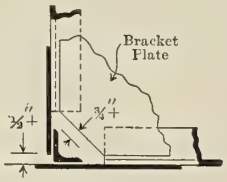


Fig. 21

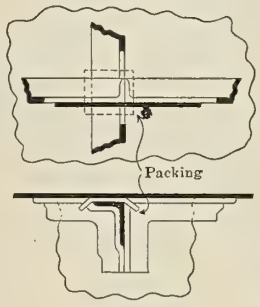


Fig. 22

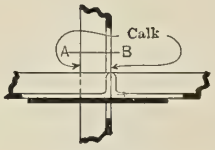


Fig. 23

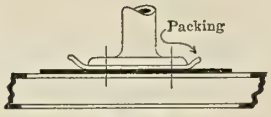


Fig. 24

As examples of three- or four-ply riveting, where packing is needed, we may point to the following two cases: A stop-water would be placed under the foot of a stanchion fastened to a watertight deck in the way of the deck beam (Fig. 24). Three-ply rivets in a joint whose central thickness is an oiltight division will usually be packed.

Materials for Packing Joints

For packing watertight joints, canvas soaked in red lead is ordinarily used. Lampwick, felt, or even paper dipped in red lead, tar, or white lead, may be employed.

For oiltight packing, felt or canvas soaked in a mixture of pine tar and shellac may be used. While red lead is sometimes employed for this purpose, it is likely to be dissolved by the oil.

A red lead gun may be used to force red lead into seams which give trouble in calking.

While books on ship construction treat in some degree certain aspects of the subject covered by these notes, they are not available in convenient form, and the writer believes that the concise manner in which they are here presented will not be without value to an increasing number of men who are devoting themselves to the various processes employed in ship construction.

Standard Cargo Ships*

British Practice in the Design and Construction of Standard Cargo Ships

BY SIR GEORGE CARTER, K.B.E.†

THE object of the paper is to place on record the advantages of standardization in the construction of cargo vessels as a war measure, and to give some account of the work of the Advisory Committee on Merchant Shipbuilding in the design and construction of what are now known as "Standard Ships."

In December, 1916, the New Ministries and Secretaries Act was passed, which provided for the appointment of a Shipping Controller. The Act gave this Minister wide powers and provided that he should "take such steps as he thinks best for providing and maintaining an efficient supply of shipping." Sir Joseph Maclay became the Shipping Controller, and the Government decided at once that merchant shipbuilding should be under his control.

Merchant Shipbuilding Advisory Committee

In December, 1916, after a conference with shipbuilders and marine engineers, Sir Joseph Maclay appointed the Merchant Shipbuilding Advisory Committee, of which I had the honor to be chairman.

The first meeting of the committee was held on December 20, 1916, and after fully considering the whole question it was decided, in collaboration with the Shipping Controller and his other advisers, to proceed at once with an extensive building programme of cargo ships of simple design and, as far as practicable, of standard types, both with respect to engines and hull. Although the Government's shipbuilding programme gave standardization in shipbuilding concrete form on a large scale, standardization had been widely discussed and urged as a practical policy both in regard to hull and machinery, and had in fact taken definite shape on a smaller scale by individual firms adopting standard types of their own.

It will be as well at this stage to call attention to the great variety of merchant vessels that were under construction at this time. They totaled nearly five hundred, with an aggregate gross tonnage of over 1,800,000 tons. Among them were found fast and slow liners, intermediate passenger and cargo types, cargo boats built for special trades, fast cross-channel steamers, vessels built to carry special cargoes, "tramp" steamers, coasting vessels, and, in fact, all the varieties usually to be found in pre-war days. Even where the types were the same, individual vessels differed in size, speed, and arrangements. Many of them were built for special purposes, and practically all of them embodied ideas that were peculiar to particular owners and builders. While many of these specialties undoubtedly served their purpose it is perhaps questionable whether a number of them were absolutely necessary. At any rate, since the standardization of cargo ships has been introduced, it is generally conceded that much of it will continue to be practiced even after shipbuilding and shipping conditions have again become normal, the reason being that in many ways economy of time, material, and labor are obtained by its adoption.

It can at once be stated that the greatest variations, both from the point of view of degree and number, were to be found in vessels carrying passengers. The need, however, for refinements of type, comfortable passenger accommodation, record passages, etc., had ceased to exist at the time of the appointment of the Advisory Committee. On the other hand, the need for plain cargo carriers, and plenty of them, was greater than ever it had been before. It was therefore decided that the vessels already under construction which fulfilled to some extent these latter conditions should proceed, and that standard ships should be constructed with all possible speed.

Standardization

The principle of standardization having been accepted, it became necessary to design standard ships to meet the most urgent needs of the Shipping Controller. It was clearly desirable to limit the types as much as possible, but apart from the requirements of the Shipping Controller the employment of the available facilities in the shipbuilding yards to the greatest advantage had to be considered. For this reason several different lengths were used for the ships, in order to use the greatest number of slips to their best advantage. Needless to say, the practical difficulties were great. No two yards had built identical vessels; each builder had his own special knowledge, his own particular type or types of vessels. Again, practice differed in different districts. The practice in one district was looked upon with disfavor in another. Shipowners, moreover, were anxious, quite naturally, to have their fleets kept up, and preferred vessels of the types similar to those built for them in pre-war days.

It has been said that if builders had been allowed to proceed in their own way and to their own designs the output of ships would have been greater than it has been under standardization. Such a contention will not bear examination when all the facts are considered impartially. There has undoubtedly been delay in the production of standard ships in spite of all the arrangements made to expedite their construction, the chief element being shortage of steel. If each builder had been allowed to proceed with his own type or types of ships, this delay would have been greater, as in addition to not getting the amount of steel required, the multitudinous sections necessary would have caused great delay in rolling at the steel mills, whose output was much increased by the simplification of sections in the standard ships, referred to later. It is not sufficient to compare the rate of production of standard ships with the pre-war rate of production. The limited supply of steel and other adverse conditions must be taken into account.

The argument that delay was caused by asking builders to construct a standard ship differing only slightly from their own type may have some justification in regard to one ship, but not to repeat ships, and it must not be forgotten that never before had a proposition been put forward to build an unlimited number of ships of similar types throughout all the yards. It is interesting also to note that in one yard a standard ship was completed in a little over six months, although the yard had never built a similar ship before. A second similar ship was also completed in practically the same time. In another yard a ship was completed, coaled, and sailed 18 days after launching.

* Paper read at the spring meetings of the fifty-ninth session of the Institution of Naval Architects, London, March 20, 1918.

† Member of Council.

In spite, however, of all the difficulties and the diverse opinions held by responsible shipbuilders and engineers, the policy of building standard ships has been loyally accepted by them, and I think it may be claimed that as a war emergency measure the policy is being justified, and will in the future be justified to a much greater extent.

Advantages of Standardization

As the policy of building standard ships in bulk is a new one, it will not be without interest to put on record some of the advantages which are claimed for standardization of this kind. They may be summarized as follows:

(1) The detail design for the type can be entrusted to a builder who is conversant with that class of vessel and whose duty it becomes to make the necessary calculations, prepare the specification and all the constructional drawings, for the information of other builders instructed to build vessels of the same type. Small details can, however, still be arranged in accordance with the ordinary practice of the individual builder.

(2) The design being in the hands of one firm, all the steel scantlings after being settled in the ordinary manner can be carefully examined to reduce the number of steel sections in the ship as much as possible. This results in producing the fewest changes of rolls at the steel works and in the rolling of much larger parcels of material to the one pattern on account of the large number of ships that are to be built to this design.

As an example of this, in the standard ships now built the number of sections are reduced to 8 or 10 as against 30 to 40 used in pre-war days for the same type of ship.

(3) All the scrieve board work would be done by one yard giving full-size frame lines, beams, side keelsons, etc., copies of which can be supplied to the other firms concerned.

(4) Steel makers and builders can agree to divide the orders for material in accordance with the facilities of the steel works, and having regard to proper times of delivery, so that the material first required is the first in order of delivery.

(5) While there is not the same difficulty with steel plates as with sections, arrangements for the proper order of delivery can be made.

(6) With machinery the advantages of standardization are probably more generally agreed upon, and more detailed attention is given to this in Appendix II. It may, however, be remarked here that the elaboration and production of design for auxiliary machinery and detailed fittings can be divided among the various makers, and each can arrange to undertake the whole manufacture of the details of a particular requirement.

This does not by any means exhaust all the advantages of standardization, for after these preliminaries have been settled many benefits arise during the construction of the ships and engines. The standard ships, although not all of the same type, have many features in common. For instance, similar sets of engines may be fitted in ships of different types, so that apart from the large number built of each type there is a still larger number into each of which a given set of engines can be placed. In the case of any one vessel and set of machinery built in the same yard, it may so happen that either hull or machinery will be completed some time ahead of the other. In such cases the machinery originally intended for one ship can be transferred to another, no matter where it is being built. These rearrangements are of great assistance in preventing, on the one hand, congestion of the engine works, and on the other, delay to vessels through machinery being behindhand.

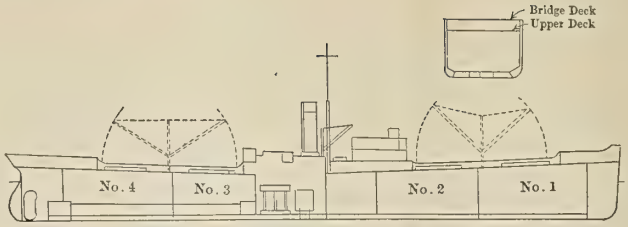


Fig. 1.—Type A. Single Decker with Poop, Bridge and Forecastle

Dimensions, 400 feet between perpendiculars by 52 feet beam molded by 31 feet depth molded; displacement, 11,375 tons; draft, 25 feet 1 inch; block coefficient, 0.762; deadweight, 8,175 tons; gross tonnage, 5,030; hull (steel) 2,225 tons; W. & O., 405 tons; engines, weight, 570 tons; light ship, 3,200 tons; engine, 27 inches by 44 inches by 73 inches by 48 inches stroke, single screw; boilers, three, 15 feet 6 inches diameter by 11 feet 6 inches.

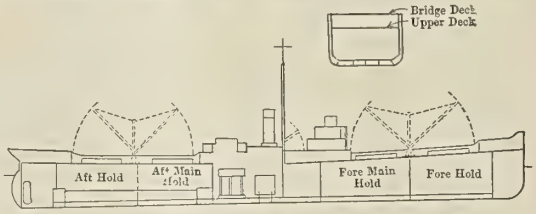


Fig. 2.—Type C. Single Decker with Poop, Bridge and Forecastle

Dimensions, 331 feet between perpendiculars by 46 feet 6 inches beam molded by 25 feet 6 inches depth molded; displacement, 7,200 tons; draft, 21 feet 8 inches; block coefficient, 0.760; deadweight, 5,050 tons; gross tonnage, 3,000; hull (steel) 1,390 tons; W. & O., 300 tons; engines, weight, 460 tons; light ship, 2,150 tons; engines, 25 inches by 41 inches by 68 inches by 45 inches stroke, single screw; boilers, three, 14 feet diameter by 11 feet 6 inches.

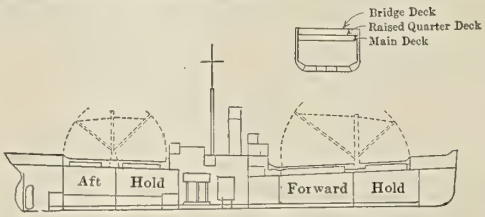


Fig. 3.—Type D. Raised Quarter Deck with Poop, Bridge and Forecastle

Dimensions, 285 feet 6 inches between perpendiculars by 41 feet 9 inches beam molded by 21 feet 2½ inches depth molded; displacement, 4,750 tons; draft, 19 feet; block coefficient, 0.732; deadweight, 2,980 tons; gross tonnage, 2,300; hull (steel) 1,110 tons; W. & O., 240 tons; engines, weight, 420 tons; light ship, 1,770 tons; engines, 25 inches by 41 inches by 68 inches by 45 inches stroke, single screw; boilers, two, 16 feet 6 inches diameter by 11 feet 9 inches.

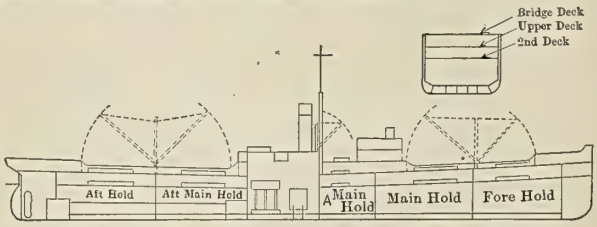


Fig. 4.—Type E. Two Decker with Poop, Bridge and Forecastle

Dimensions, 376 feet between perpendiculars by 51 feet 6 inches beam molded by 29 feet depth molded; displacement, 9,910 tons; draft, 23 feet 9 inches; block coefficient, 0.749; deadweight, 7,020 tons; gross tonnage, 4,400; hull (steel) 1,920 tons; W. & O., 400 tons; engines, weight, 570 tons; light ship, 2,890 tons; engines, 27 inches by 44 inches by 73 inches by 48 inches stroke, single screw; boilers, three, 15 feet 6 inches diameter by 11 feet 6 inches.

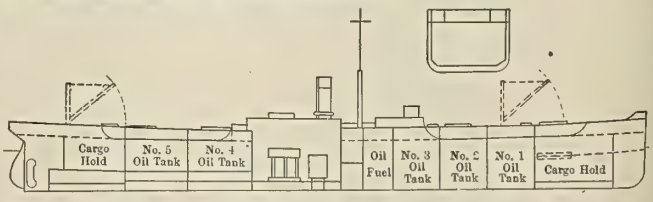


Fig. 5.—Type Z. Single Decker with Poop, Bridge and Forecastle

Dimensions, 400 feet between perpendiculars by 52 feet beam molded by 31 feet depth molded; displacement, 11,400 tons; draft, 25 feet 1 inch; block coefficient, 0.762; deadweight, 8,000 tons; gross tonnage, 5,800; engines, weight, 570 tons; light ship, 3,400 tons; engines, 27 inches by 44 inches by 73 inches by 48 inches stroke, single screw; boilers, three, 15 feet 6 inches diameter by 11 feet 6 inches.

The auxiliaries and fittings, including forgings and castings, being alike in vessels of each type, can be ordered in large numbers from the same maker and used in any ship or ships which may be ready to receive them.

Standard Ships

Outline profiles and midship sections are given of some of the standard ships in Figs. 1 to 5, together with their principal dimensions and particulars. The general arrangement of the machinery as fitted is shown in Fig. 6.

The first two designs made were the "A" and "B" types. Both these vessels are of the same dimensions, but the first is of the single-deck, and the second of the two-deck type; their length is 400 feet, and deadweights 8,200 and 8,100 tons, respectively.

These types were followed by the "C" type, length 331 feet, and deadweight 5,050 tons, and the "D" type, length 285 feet, 2,980 tons deadweight.

The "C" and "D" types were laid down on the shorter berths as they became available, and later the "E" type was added so that the best use might be made of berths exceeding the "C" vessels' length, but under the "A" and "B" length; the "E" type is 376 feet in length and 7,020 tons deadweight.

For these five types of vessels two standard types of engines only were required. The "A," "B," and "E" vessels are all fitted with the standard "A" engines. The "C" and "D" vessels again have a type of engine common to both, although in the case of the "C" type additional boiler power is provided.

To meet the urgent need for more oil carriers an important alteration was made later in the construction of a number of the "A" and "B" type vessels, through which, if the necessity arose, they could be completed as oilers.

In addition heavy oil carriers of 8,000 tons capacity known as the "Z" type are building. The overall dimensions of the "Z" vessels are the same as the "A" and "B"; the same standard type of engines are used as in the "A," "B," and "E" vessels.

All the types mentioned, except the "Z" oiler, were decided upon, the designs prepared, and details arranged while the Merchant Shipbuilding Advisory Committee was still meeting at the Ministry of Shipping, and other types were projected.

In designing the standard ships a point kept in view was the necessity for producing as quickly as possible plain cargo boats of the maximum carrying capacities with the least expenditure of material and labor, and of sizes most suitable to the majority of building berths, and shipping conditions, etc. I feel that it is necessary to emphasize this statement because obviously the Government standard ships were designed to meet urgent war conditions. While they might have a bearing on future standardization, the question has not been dealt with from a peace standpoint.

The detailed design of each type in the first place was entrusted to a builder conversant with the class of vessel required and whose duty it was to carry out the work already mentioned. The engines were dealt with in a somewhat similar manner except that one Scotch and one English engineer used to the class of work collaborated on the one design and its details—these and the designs of the ship afterwards meeting that the full assent of the committee. It was arranged with the Classification Societies should concur in the various scantlings, and undertake, on behalf of the Ministry of Shipping, the entire supervision of the vessels during construction. Two surveyors of Lloyd's Register who had been associated with the Ministry of Munitions in the production of steel were assigned the duty of allocating the orders for steel material to the steel works and of arranging for its distribution to the builders in conjunction with the Government officials as required.

To facilitate the loading and discharging of cargoes large hatchways were arranged with an ample provision of derricks and winches. In the same connection the pillars were specially arranged as mentioned in Appendix I. Further points of detail are discussed in Appendix I for the hull and in Appendix II for the machinery.

General Considerations

As experience was gained with vessels already at sea which had received damage by mine or torpedo, it was only to be expected that modifications would be suggested. For this reason certain alterations were effected in the early standard ships after the plans were prepared. These were principally made on the advice of the anti-submarine authorities; but one other particular alteration is worthy of mention, in that greater safety and comfort is given to the crew by quartering them in the poop rather than in the forecastle, as was the usual practice before the war.

It will be remembered that the Council of the Institution formed a committee last year to consider the question of the effect of mine and torpedo explosions on the structure of merchant ships. The majority of the findings of this committee, it will interest members to know, were embodied in the standard ships.

Certain precautions were taken to render the visibility of the standard ships as small as possible. Some of these can be mentioned, while others had better be left unnoticed. The derricks and derrick posts were made to hinge down, and there is only one mast for carrying the wireless aerials. This latter is partly telescopic and can be let down to the same level as the top of the funnel. The funnel is also made lower than usual. Ordinary deckhouses were fitted, and these in conjunction with other outstanding features of the ship can be masked by those on board when desired by the use of arrangements provided.

The speed and horsepower of the standard vessels have purposely been omitted from this paper. There must be many to whom these particulars are familiar. Perhaps there are still some who think that the vessels should have been given greater speeds, although the speeds are somewhat higher than is usual for this type of ship. The direct answer to this is that the actual speeds were concurred in by the Admiralty, who were in a position to know the requirements in that direction better than anyone else. This was the guiding factor of the committee; but it cannot be overlooked that increase of speed in any ship can only be obtained at great cost, and this is particularly the case in cargo ships of full form. Apart from this, at the time the standard ships were designed, consideration was given to the successful commercial use of these vessels after the war. Nevertheless, the great loss in cargo-carrying that would be entailed by fining up the lines, increasing the power of the engines, and the fuel that the vessel would have to carry, etc., must be considered when the question of speed is being viewed from all standpoints.

The bulkheads of the standard ships are discussed in Appendix I, but it may not be out of place here to refer to what are termed "unsinkable" ships. The word "unsinkable" must, of course, be used in a relative sense, because any ship can be sunk provided she receives a sufficient amount of damage. Advocates of unsinkable ships themselves usually specify that the word only applies to some definite amount of damage. Any responsible naval

architect can design such an unsinkable ship, and actually many such designs were submitted to the advisory committee. There is one objection, however, which is common to all such types of vessels; in every case they require the expenditure of more steel per ton of deadweight carried. At the time the advisory committee was formed, as has already been indicated, steel was extremely scarce. Apart from this, all provisions for safety, if of an appreciable value, must complicate the cargo arrangements. Some curtail the amount of cargo carried, and all render it more difficult to handle the cargo. This, apart from increased steel required in construction and lengthened time of building, further limits the carrying capacity of the ship by increasing her time for loading and unloading.

Conclusion

In May, 1917, the Department of the Controller of the Navy was formed and the work hitherto done by the Ministry of Shipping in connection with merchant shipbuilding was transferred to the new department. The merchant shipbuilding advisory committee was also transferred, but shortly after this, for reasons which need not be stated here, the committee resigned and the Controller of the Navy immediately formed a Shipbuilding Council to assist him in regard to all matters respecting shipbuilding, both merchant and warship building and repairing. The members of the old advisory committee became members of this council.

Further types of standard ships have been evolved recently, but I do not propose to include them in this contribution. Enough has been said to illustrate the general principles involved.

To introduce any general system of standardization of ships would have been difficult in normal times; it is only to be expected that it has proved to be so even in the midst of the greatest war in history. On the other hand, the need having arisen so acutely, called for the attempt to be made. That criticism has arisen as to the Shipping Controller's policy, and the advisory committee's action, was only to be expected when one considers the eminent ship designers and shipowners who have special ideas and interests in the design of some ships already built, and the many ideas that have at one time or the other been proposed. That good results have, however, been attained will, I have no doubt, be generally conceded, and the appointment of a committee to consider the general standardization of marine engines is a sign that we may expect standardization to play a definite part in the future. In post-war work we shall have to consider everything making for cheapness and rapidity of production, and standardization will not be the least among such considerations.

APPENDIX I

Hull Details

In all the vessels the longitudinal and transverse scantlings have been designed generally to comply with the standard of strength recommended by the load line committee.

With a view to obtaining simplicity of construction, special consideration was given to the arrangement of the details of the structure, and it was decided to omit the ceiling on the tank top and the stringer on the ship's side, to fit only one keelson on each side in the double bottom, and to have large single angles at the upper and lower edges of the center girder, suitable structural compensation or arrangements of equivalent strength being fitted in each case. The open bottom method of construction with solid floors on every third frame was adopted in the holds and boiler space, except in types "C" and "D," where, on account of the probability of these vessels being engaged in carrying ore and coal cargoes, solid floors are fitted on every frame throughout.

To reduce labor and avoid the necessity of bending the main frame, brackets of extra depth are fitted on the tank margin and no tumble home was given to the frames at the top sides. Only a center row of pillars, reeled for shifting boards, was fitted (except for hatch side pillars in types "B" and "E"), and advantage was taken in several instances of the relative position of the hatchways and watertight bulkheads to support the deck by large brackets attached to the bulkheads, the holds being thus as free as possible from obstructions of any kind. To compensate for the absence of pillars at the sides of the hatchways, an arrangement of reinforced hatch-end-beams and side coamings was adopted, the latter being also incorporated in the longitudinal strength of the ship in the way of the hatchways nearest amidships. In types "B" and "E," on account of the excessive depth required in the reinforced hatchways, side coamings and end beams at the second deck, when center pillars only were fitted, it was decided to fit a pillar under each hatchway side coaming at the middle of the length of the hatch.

The officers and engineers, in accordance with the most recent practice, are berthed together in a large house at the fore end of the bridge deck.

Approximate flooding calculations were made for all types of the standard ships.

In vessels "A," "B" and "E," with the main bulkheads in the positions arranged by the builders, it was found that, by making the cross-bunker bulkhead watertight, the vessels would approximately comply with the "two compartment" standard in way of the machinery space and cross bunker, and the "one-compartment" standard elsewhere. The position of the cross-bunker bulkhead was arranged in order to fulfil the above-mentioned conditions.

In vessel "C," in addition to the bunker bulkhead, an additional bulkhead was fitted in the after hold, in order to comply with the same condition.

Among the detailed requirements carried out in these ships which meet the findings of the committee appointed by this Institution to inquire into the effects of mine and torpedo explosions might be mentioned the following: No watertight door is fitted between the engine room and the shaft tunnel, an access trunk being provided from the upper deck to the forward end of the tunnel. In addition, where watertight doors are fitted, they can be worked from an upper-deck position. Each suction pipe, where it enters the compartment from which it drains, is provided with a screw-down non-return valve worked from the bulkhead deck.

APPENDIX II

Engine Details

The details of the engine design are arranged so that the machinery is rather overdriven for war emergency measures; this policy was followed so that after the war the ships become fairly reasonable commercial propositions. For example, the "A" engine would in peace time probably run at about 80 percent of the power obtained from it at present.

As with the hull, all the designs, when settled as previously mentioned, with the exception of the auxiliary machines, were prepared by one firm and issued to the various machinery contractors complete, together with full detail specifications of all the raw material orders and the finished items which it was arranged to obtain from subcontractors. The drawings and information issued contained quite an unusual amount of detail, so that firms not

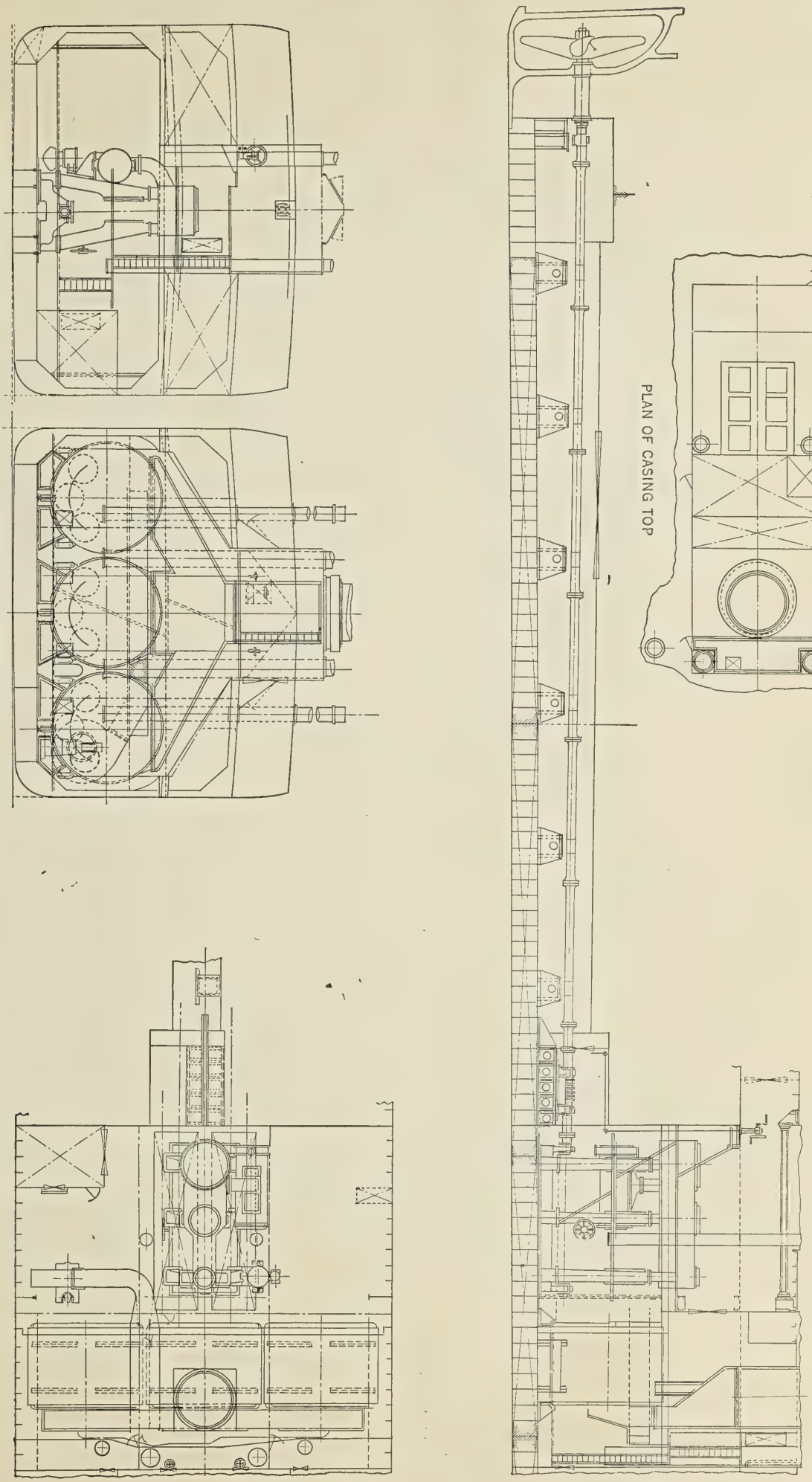


Fig. 6.—General Arrangement of Machinery for Standard British Cargo Ships

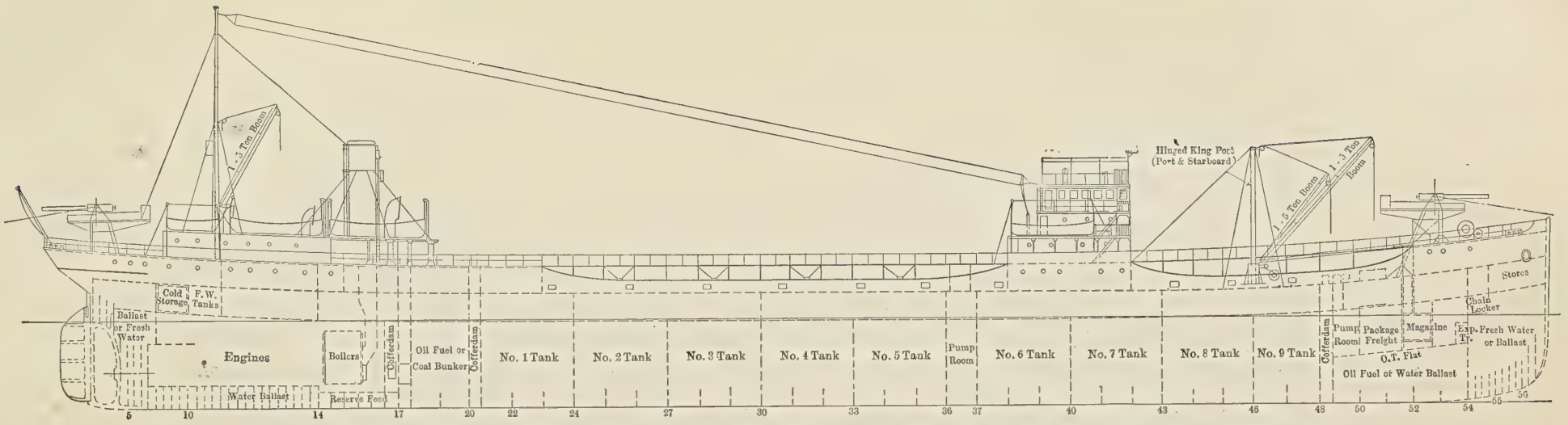


Fig. 1.—Usual Type of Standard 10,000-Ton Oil Tank Steamship, Designed and Built by the Sun Shipbuilding Company, Chester, Pa.

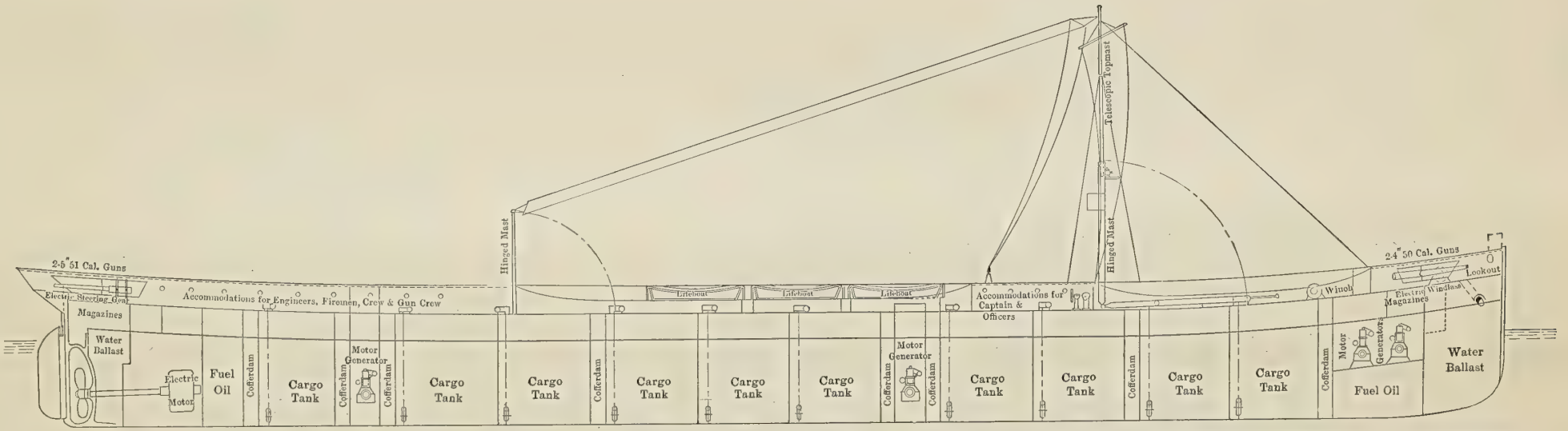


Fig. 2.—Modified Design of 10,000-Ton Oil Tanker Proposed by the Sun Shipbuilding Company. Tanks Are in Pairs Separated by Cofferdams with Independent Bulkheads. Large Machinery Space Is Eliminated by Adoption of Electric Drive, the Current Being Supplied by Six 700-Horsepower Oil Engine Driven Generating Sets Distributed in Small Compartments Throughout the Vessel. Low Visibility Secured by Elimination of Smokestack, Deck Houses and Rigging

familiar with such work would have no difficulty in carrying it out.

The main engine design does not present any new features. There are, however, some outstanding details. The front columns which carry the astern piston rod guides have been utilized as engine oil tanks. The moving parts of the engine are of the simplest type, and every attention has been paid to facility for overhaul.

The line shafting is all in interchangeable lengths.

The reversing gear is of the all-round type, and a turning engine and gear is fitted at the after coupling.

Ease of machining and assembling has been provided for in the arrangement and in the details, the piston type of valve for the medium pressure cylinder, for example, being adopted chiefly on that account. The centrifugal circulating pump is mounted with its engine on the main engine bedplate, so that it can be fitted complete with its pipes and connections in the erecting shop.

Reference has been made in the paper to the advantages derivable from interchangeability, and examples of it have actually occurred. One firm, on discovering a defective sole plate casting, had it replaced at once by a similar casting from another firm who did not require it at the time; this avoided a delay of several weeks in the erection of the engines. In another case a replaced main steam pipe branch piece was immediately dispatched to a vessel ready for her trial trip, the original one having shown leakage on the first steaming of the engine. Sub-contractors in particular were benefited by the multiple work, as they were enabled to proceed with a large number of each article instead of finding differences in small points of design, as invariably occurs when the designs are prepared by independent firms or individuals.

The principle of repetition in designs was embodied everywhere. Small castings were ordered in multiple.

Apart from the advantage to the sub-contractors in carrying out repeat-work, small items in the engine room which could be manufactured to better advantage by specialists rather than by large firms were ordered in large numbers for all the firms involved. This would not have been possible had they been different for each vessel. The orders for items such as auxiliary machinery, valves, valve boxes, branch pieces, cast and wrought iron pipes, and so on, were issued in multiple from a single source by firms specializing in this work. For example, the main steam pipes were finished complete by tube makers, the drawings having been so designed that the unavoidable inaccuracies in fitting boilers and engines in place could be taken up at the joints, thus overcoming the delay which otherwise invariably occurs when pipes have to be made to fit after everything else is in position.

The auxiliary machinery was arranged so as to give the least work in completing the vessel after it was launched, the various connecting pipes being of the simplest form while providing all the usual conveniences for working.

The feed filter and feed heater were embodied in a compact form in the engine hot well, the feed filter being easy of access. The winches exhaust to a winch condenser in the engine room, the size of which is ample to deal adequately with the winches when they are being used for a rapid discharge of cargo. The general service donkey and harbor feed donkey are duplicates, and are capable of feeding the boilers in port or at sea.

The use of copper piping was avoided as much as possible, and wrought iron was largely used in consequence, except for very small pipes. The result is that the weight of copper piping is less than one-sixth the usual amount in this class of vessel.

The boilers are fitted with Howden's forced draft.

Modified Design of Standard Tanker

IN common with other ship owners, the Sun Oil Company, of Philadelphia, has not been able to escape entirely the ravages of the German submarine warfare. Several of its vessels have been sunk by German torpedoes and their experience has led the Sun Shipbuilding Company, Chester, Pa., to work out the design of an oil tanker in which the risk of loss from torpedo or mine attack can be materially lessened.

In the past, tankers have been sunk either by being hit in the engine room—in which case the vessel sinks because there is not sufficient reserve buoyancy to keep it afloat—or the vessel is struck forward of the engine room and the bulkheads forward of the machinery space are blown out, so that the vessel catches fire or the engine room is flooded, or the vessel is struck forward, bringing the vessel down by the head to such an extent that water gets in the 'tween deck space and, gradually working its way aft, finally destroys the reserve buoyancy. These are results which have been brought about with vessels designed with the usual standard arrangement, as shown in Fig. 1, on the opposite page.

The modified design, shown in Fig. 2, provides protection against all three of the contingencies enumerated above. The main oil tanks are arranged in pairs, but a cofferdam is interposed between each pair of tanks. The bulkheads forming these cofferdams are absolutely independent of each other. With this arrangement the explosion of a torpedo in any one of the tanks, it is believed, will be limited to the space between the cofferdams forward and aft of the pair of tanks. All of the bulkheads run up to the upper deck and the explosion of a torpedo on one side of the cofferdam would affect only one of the cofferdam bulkheads, as the two are entirely separate, the space between giving a vent for the explosive pressure in the tank.

In the modified design, the large machinery space aft is done away with entirely, so there is no large compartment in the ship, the flooding of which would mean its destruction. In place of the usual arrangement of propelling machinery, the vessel will be driven by an electric motor located in a small compartment aft and supplied with current from a number of oil engine-driven generators distributed in various parts of the vessel. In the design shown there are three separate generator rooms, each being protected by cofferdams on either side. In all, there are six 700-horsepower motor-driven generators, giving over 4,000 horsepower, which is sufficient to give the vessel a speed of 12 knots, as against 10½ knots in a similar steam tanker. This method of propulsion, at the same time, will save 1,000 tons in fuel on a transatlantic voyage, which means that the vessel can deliver 1,000 tons more cargo on the other side.

The trim of a modified vessel, in case she is struck by a torpedo, is taken care of by large rotary pumps installed in each side of each tank and driven by electric motors from the upper deck. This is a system which has already proved its usefulness in practice on several tank steamers now in use, the most notable installation of the kind being on the Union Oil Company's steamship *La Brea*.

The average steam vessel, when struck with a torpedo, is immediately crippled. This modified vessel, however, it is claimed, can still run at a fairly good speed and can maneuver so that it continues to be dangerous for submarines until struck in the motor room at the extreme after end of the ship. At this point, however, it is believed that the water, due to the action of the propeller, is so turbulent that it would be practically impossible for the torpedo to strike the vessel, as it would be diverted

and thrown away from the ship. Careful investigation has failed to discover a single instance where a ship of this model has been so struck or the torpedo drawn into the propeller.

Besides the protective features against torpedoes, however, this modified design has the further great advantage of minimum visibility. The hull presents an absolutely straight skyline from stem to stern. There are no deck houses, funnels or other erections above the deck level except a single mast for the wireless, which, however, is hinged and can be lowered below the deck line. The hull is of the three-island type, with forecastle, bridge and poop. These decks are connected by a fore-and-aft bridge, to the lower side of which are hung light hinged plates to fill in the open space between the fore-and-aft bridge and the top of the bulwarks, filling out the profile so that the skyline is absolutely straight, which, with the absence of funnels and smoke, reduces the visibility of the vessel to an absolute minimum.

The standard design of tanker can be utilized for a vessel of this type, and vessels of the modified design can be built practically as rapidly as the standard design of tank steamers. Estimates show that the cost of the modified design is less, while the operating expenses will be reduced in the same proportion as in the case of an ordinary motorship.

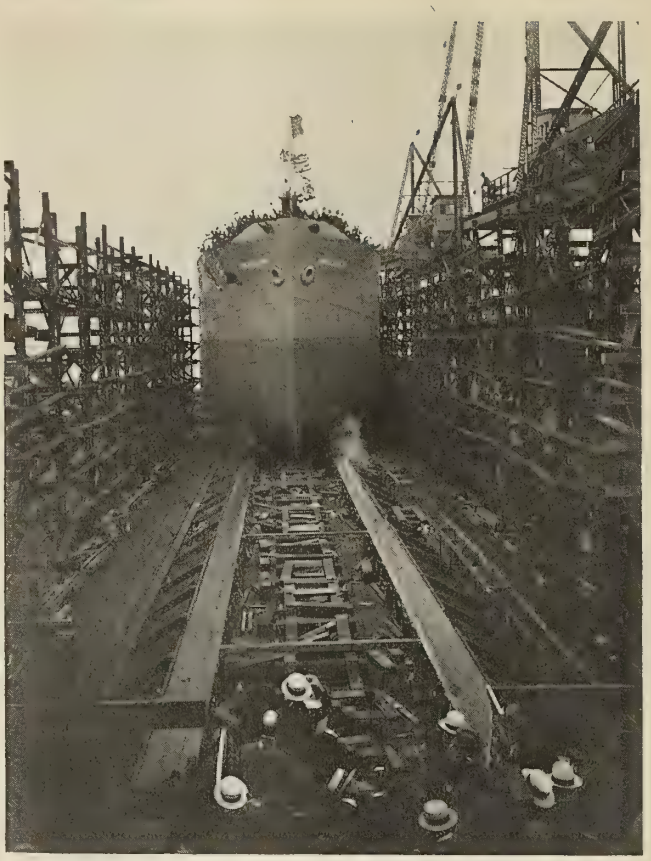
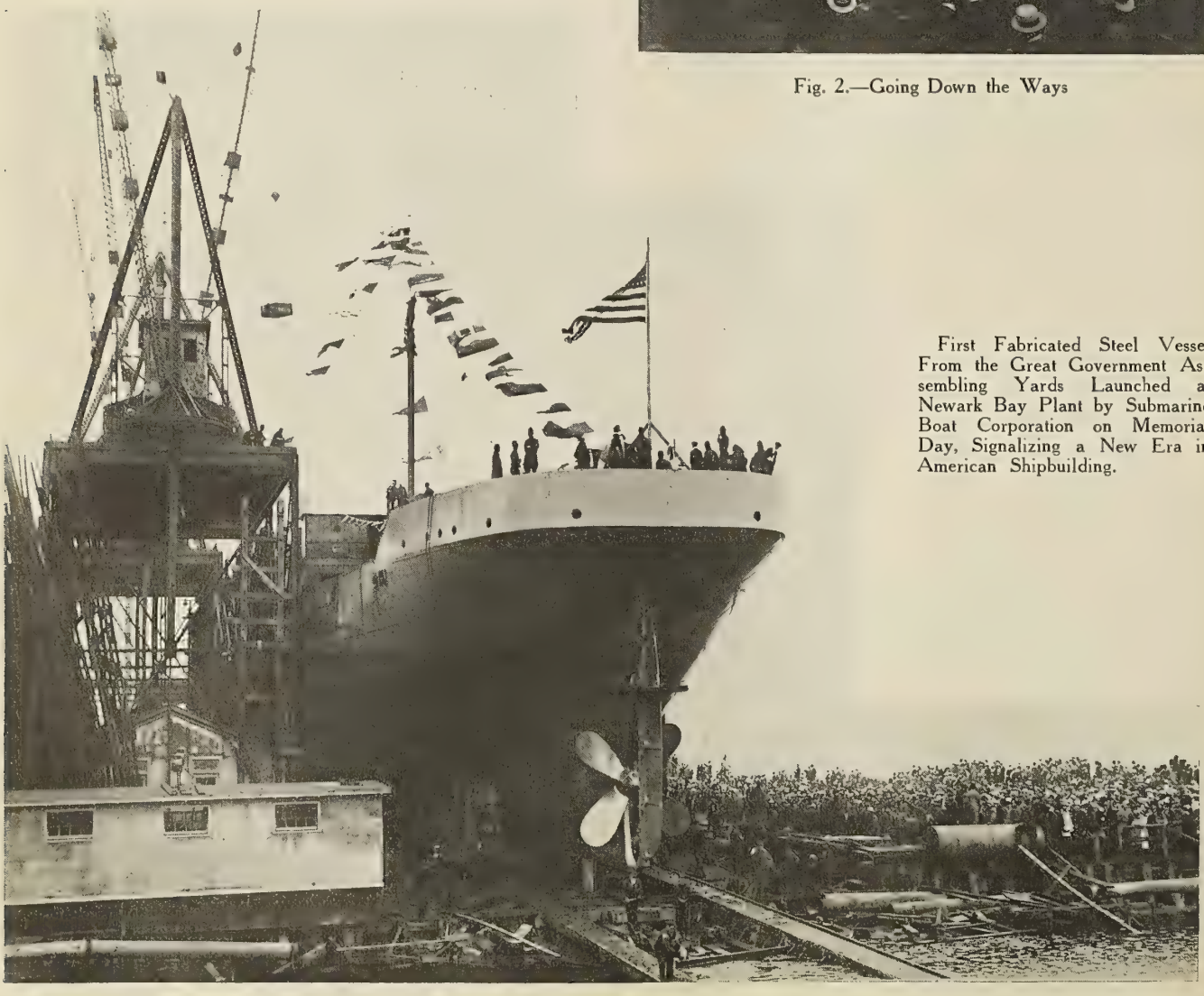


Fig. 2.—Going Down the Ways



First Fabricated Steel Vessel From the Great Government Assembling Yards Launched at Newark Bay Plant by Submarine Boat Corporation on Memorial Day, Signalizing a New Era in American Shipbuilding.

Fig. 1.—S. S. *Agawam* Ready for Launching

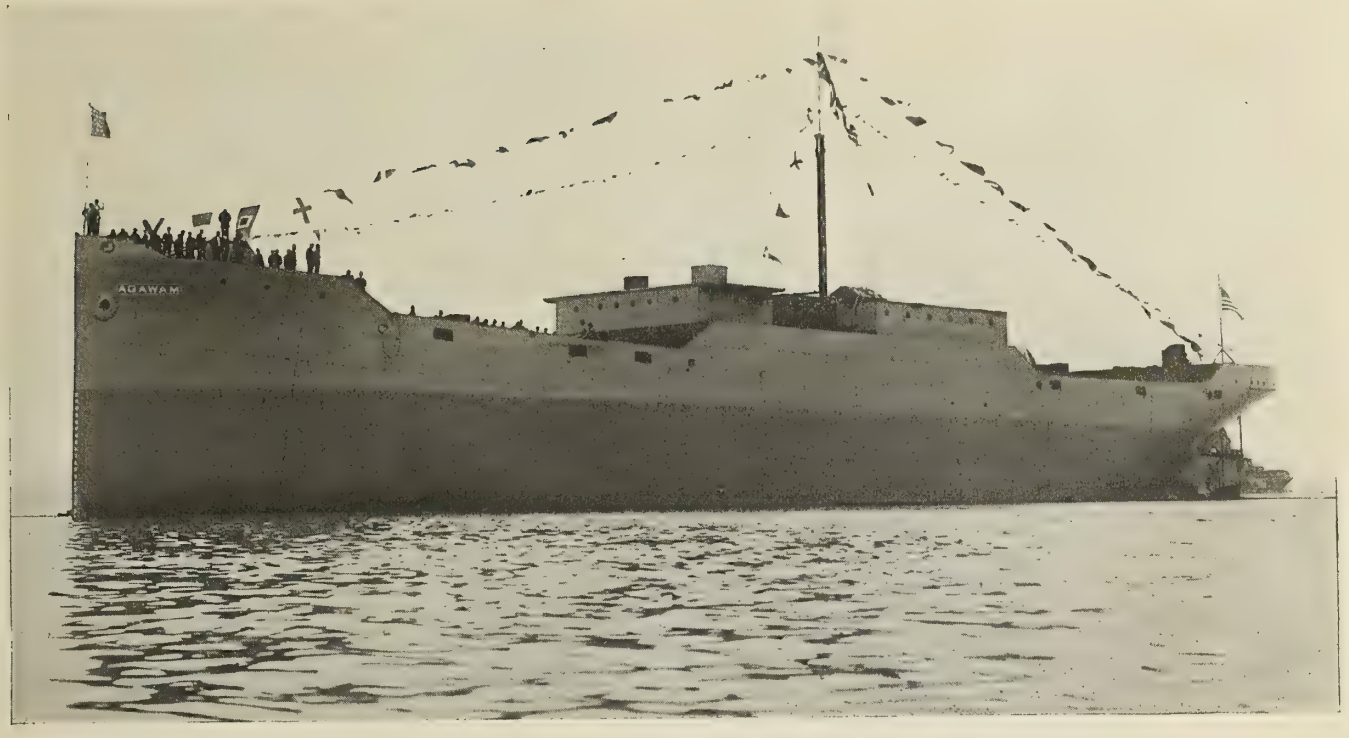


Fig. 3.—Side View of the *Agawam* Immediately After Launching

This design, which it is believed will remove at least 90 percent of the submarine risk, has been offered to the Shipping Board by the Sun Shipbuilding Company, so that any shipyard in the country equipped for building tank steamers can make use of it without restrictions of any kind.

Launching the First Government Fabricated Steel Ship

The first vessel to go into the water from the big government yards for assembling fabricated steel ships was the *Agawam*, which was launched by the Submarine Boat Corporation, at the Newark Bay Plant, on May 30. Nearly ten thousand persons witnessed the ceremony, among them being Charles M. Schwab, Director General of the Emergency Fleet Corporation, Thomas Edison, chairman of the Naval Consulting Board and many of the leading shipbuilders on the Atlantic Coast and Great Lakes.

The vessel was christened by Miss Mary E. Ward, Mr. Schwab's niece. Following the launching, addresses were made by Director General Schwab and officials of the company, emphasizing the significance of the event and the rapid development of the government shipbuilding programme.

Fig. 4.—View of the *Agawam* Showing Slight Flare at the Bow and Extent of Parallel Middle Body

The outstanding feature of this launching is the fact that the *S. S. Agawam* is the first standardized steel cargo vessel built from structural steel shapes and plates to be launched for service of the Emergency Fleet Corporation. All other vessels of both steel and wooden construction launched at the various yards on the Atlantic coast during the last few months were ships that had been privately contracted for and commandeered during construction by the United States Shipping Board.

The various steel parts of the vessel's hull and superstructure were fabricated as completely as practicable in structural steel shops throughout the country and then assembled at the Newark Bay Shipyard into a complete vessel. This is a decided innovation in the

shipbuilding industry and gives promise of great success in economy and speed of production heretofore not thought possible.

Approximately 27 steel mills, 56 fabricating plants and 200 foundries, machine, pipe, joinery, and equipment shops, are engaged in the production of the parts to make up the finished steamship.

The *Agawam* will have a displacement of approximately 7,800 tons when loaded to the Plimsoll mark, and a deadweight carrying capacity of about 5,500 tons. The length of the vessel is 343 feet on deck, the molded breadth being 46 feet and the molded depth of hull, 28 feet and 6 inches. The maintained speed of the vessel at sea fully loaded, will be at least 10½ knots on a mean draft of approximately 23 feet.

Propelling Machinery

The main machinery consists of a Westinghouse steam turbine operating at 3,600 revolutions per minute, driving the single screw propeller at 90 revolutions per minute through a Westinghouse balanced floating type reduction gear. Steam supply to the turbine will be furnished by two Babcock & Wilcox marine-type watertube boilers, which were installed in the ship before launching. The auxiliary machinery of the vessel will be most complete, including duplicate electric light plants, refrigerating plant, pumping machinery for numerous systems, forced-draft blower, evaporator, heaters, cargo handling machinery, windlass, capstan, steering engine, auxiliary condenser, etc. Fuel oil will be used in the boilers for generation of steam, this fuel being carried in compartments of the double bottom of the ship in sufficient quantity to more than cover the round trip to Europe.

Ample and comfortable quarters are provided for officers and crew.

As every vessel to be built at this shipyard is of the same size and type, the time required for construction and completion will be much less than has heretofore been required for such work, and from the 28 construction-ways in this yard it will be possible to launch hulls on an average of at least two and possibly three per week, insuring delivery from the fitting-out docks, ready for sea, at the same rate of completely finished ocean-going steamships.

Mrs. Woodrow Wilson has most appropriately selected names of Indian origin for the vessels of the Emergency Fleet Corporation and has made a particularly happy choice in the name of *Agawam*—a literal translation of which is "Great Salt Meadows of the Atlantic Coast."

Structural Steel Used Exclusively

The fabrication of steel cargo vessels using exclusively structural steel shapes and plates which have hitherto been employed only in the erection of bridges, office buildings, theatres, etc., is the original idea of Mr. Henry R. Sutphen, vice-president of the Submarine Boat Corporation and was worked out to a practical conclusion in conjunction with bridge builders and naval architects. Mr. Sutphen had suggested and supervised the building of 550 submarine chasers for the British Government in 1915 and 1916, which were delivered in the incredibly short time of 550 days from the signing of the contracts. This tremendous undertaking proved the efficacy of standardization in shipbuilding and was the "tryout" for the bigger job that is at present being undertaken.

Making experiments at sea may result in having to limp into port. Make experiments as close to a repair shop as possible.

Steamboat-Inspection Rules Amended

The steamboat-Inspection Service has issued a circular letter dated May 27, 1918, addressed to inspectors of the service, steamboat companies, and others concerned, containing amendments of the General Rules and Regulations of the Board of Supervising Inspectors and approval of vessel equipment adopted by the executive committee of the board, at a meeting held from May 11 to 22, inclusive, 1918, as follows:

Carrying of Kerosene (Paraffin) and Lubricating Oils on Steam Vessels

The following resolution prescribing the method of carrying kerosene (paraffin) or other illuminating oils and lubricating oils on steam vessels, in pursuance of a recent act of Congress, was adopted:

Resolved, That in order to carry into effect the amendment to section 4472, R. S., as provided in bill S. 1546, Sixty-fifth Congress, "An act to permit the use of certain refined products of petroleum as stores on steam vessels carrying passengers," approved March 29, 1918, the following regulations are hereby prescribed for the storage of kerosene (paraffin) and lubricating oils, viz.:

Lubricating oils may be stored as heretofore in secure tanks, casks, or cans in the engine-room compartments or storeroom, or in metal-lined lamp lockers or oil rooms. Kerosene (paraffin) or other illuminating oils meeting the requirements of the law must be stored in metallic tanks or cans, and carried in the oil rooms or lamp lockers constructed in accordance with the general rules and regulations.

Stamping of Heads and Butt Straps of Boilers

The following resolution relating to method of stamping of heads and butt straps of boilers by inspectors was adopted:

Resolved, That the paragraph under the heading, "Test of plates for butt straps or boiler heads," as contained in the Eighth Supplement to General Rules and Regulations issued November 15, 1917, be amended by inserting after the word "stamp" in the last line of the said paragraph the words, "in one place where it is most likely to be left legible after working into the boiler," so that the paragraph as amended shall read:

TEST OF PLATES FOR BUTT STRAPS OR BOILER HEADS

Resolved, That, until further ordered, inspectors testing iron or steel plate at the mills where same is manufactured shall allow the mills to shear any plate into butt straps or heads before the coupon from the plate is tested, and they shall accept the statement of the manufacturer that the coupon presented to the inspectors for testing was taken from the plate from which the butt straps or heads were cut, and if the coupon meets all the requirements of Rule I, Rules and Regulations of the Steamboat-Inspection Service, the inspector shall stamp in one place where it is most likely to be left legible after working into the boiler all heads and butt straps cut from the plate.

Vessel Equipments Approved

The following-described vessel equipments were approved:

Kapok life-preserver jacket, presented by the G. H. Masten Company, New York, N. Y.

Sanitary Java kapok life-preserver vest, presented by the Everfloat Life Preserver Company, New York, N. Y.

Coston improved life belt (combination cork and kapok), presented by the Coston Supply Company, New York, N. Y.

Cambridge life float, presented by The T. J. Flynn Metal Works (Inc.), Cambridge, Mass.

Sweeney life float, presented by the Herreshoff Manufacturing Company, Bristol, R. I.

Fire gun fire extinguisher No. 1, 1 quart size, carbon tetrachloride, manufactured by the Fire Gun Manufacturing Company (Inc.), New York, N. Y.

The above action of the executive committee received

the approval of the Secretary of Commerce on May 25, 1918, under the provisions of sections 4405 and 4491, Revised Statutes.

The Future of the German Merchant Marine*

WITH no branch of Germany's economic life has the world war played such havoc as with German over-sea shipping. A good two-thirds of the collective German trade fleet has, up to the present, through seizure or capture, fallen into the possession of the enemy or been sunk, or else appears to be greatly imperilled.

To this must be added the frequently overlooked fact that German over-sea shipping firms have, since the beginning of the war, despite the absence of any income worth mentioning, been obliged to spend, month in and month out, enormous sums for keeping their ships lying in neutral harbors in good condition, for harborage, and for the hire and support of the seamen on these ships—expenditures which have, of course, gradually become less with the entrance of the majority of the States originally neutral into the coalition against us, yet which still to-day require considerable quotas. There must, furthermore, be added the taxes at home, the cost of keeping in condition the ships lying here, the usual business expenses, the support of those employees who have joined the colors and of their dependents, and much besides.

Tthe handsome profits which some of the large German shipping firms have gathered since 1916 through the transportation of iron ore and coal in the Baltic Sea can, in the face of these expenditures, hardly be considered as more than a drop upon a hot stone.

Serious After-the-War Competition

If the predicament of the German over-sea shipping firms appears on the very face of matters to be an extremely difficult one, it appears still more perilous when it is compared with the foreign competition that it must meet on the world's seas after the end of the war, for the shipping companies of the neutral and enemy countries have earned altogether fantastic sums during the years of the war. They have thereby not only been in a position to declare dividends of unprecedented size, but have in addition to this also transferred vast sums to reserve and emergency funds, whereby their ability to compete against the weakened German shippers has increased to such an extent that one cannot but face the coming war of competition with concern.

There has, furthermore, arisen in the neutral countries a lot of new and, at the same time, exceptionally well capitalized shipping enterprises that will likewise have a weighty word to say in the shipping rivalries after the war.

"Outlook by No Means Rosy"

A survey of the situation will lead inevitably to the admission that the outlook for the German over-sea shipping firms after the war is by no means rosy. The German Government's gratifying measures of assistance in favor of the shipping trade do not alter the situation in the least. For even if the shipping firms are granted considerable sums for the construction of ships to replace the ones lost, in accordance with the provision for the reconstruction of the German merchant marine, yet, on the other hand, the sums to be paid out according to the law are so adjusted that even in the most favorable cases the shipping firms have at least to bear a portion of the cost of reconstruction, equivalent to the value of the ship in peace times. The indebtedness of the shipping firms will therefore, in spite of the law, be subjected to a still greater increase before they obtain possession of sufficient tonnage to enable them to resume the struggle for their former fields of activities. This fact alone reveals plainly enough that the law amounts much less to a patronage of the shipping concerns than a measure for the extension of German foreign trade, of German economic life in general, which without a speedy reconstruction of the German merchant marine would have to pay millions of marks yearly to foreign countries, if any even approximately sufficient tonnage be put at its disposal at all, considering the scarcity of ocean-going vessels.

German shipping firms will have to apply every possible energy and influence in order to reconquer their former place in the sun. As things are situated there need be expected no handsome dividends for years to come, even should the high freight rates now prevailing be paid for any considerable time after the war, which possibility is justly doubted in shipping circles. The profit of the first few years will in all likelihood be appropriated, for the most part, for the immediate payment of the obligations assumed during the war and for those to be assumed for the reconstruction of ships, as well as for the completion of the reserve funds, which naturally will have to be put to considerable use.

* Translation of an article by Oskar Linder, of Hamburg, in *Norddeutsche Allgemeine Zeitung* of March 31, as printed in *Commerce Reports.*

New Orleans Trains Navigating and Engineering Officers for America's New Merchant Marine

BY MEIGS O. FROST*

WHEN the average citizen learned recently that present construction plans for the new American Merchant Marine called for more than 8,000,000 tons of new shipping to be completed within two years, he had absolutely no realization of the problems involved. Huge as was the physical problem of building 8,000,000 tons of new shipping, a problem equally great was the training of officers to command that fleet. Not merely navigating officers but engineering officers as well. And in addition to this came the problem—equally great—of training merchant marine crews.

Since the days when the American clipper ship went out of existence, the United States did not lose merely the commercial supremacy of the seas. She lost as well her deep-sea ideals, and the United States Shipping Board was confronted with the problem of officering and manning the huge fleet that America needed to win the war from a people whose thoughts were the thoughts of landlubbers.

Maritime statistics at the beginning of the world war in August, 1914, showed America second to Great Britain, with the 7,928,688 tons of shipping under the American Flag. But of that tonnage accredited to the United States, only approximately 2,000,000 tons was available for deep-water service in the Atlantic. Those bald tonnage figures show, as nothing else, the huge maritime problem that confronted America.

The United States Shipping Board faced that problem and solved it.

Three days after Henry Howard had been sworn in as director of recruiting service for the Board on May 29,

* Special Agent, U. S. Shipping Board Recruiting Service.

1917, the first free United States navigation school in America was opened with the twenty students at Harvard University. The work of organizing additional schools went steadily on through succeeding months until forty-one in all were established on the Atlantic, Gulf and Pacific Coasts and on the Great Lakes.

Shipping Board representatives, coming to New Orleans, found the South's ancient seaport peculiarly in a mood to co-operate. The shipbuilding idea had permeated completely New Orleans' commercial life. Just

Commodore Ernest Lee Jahncke, Chief of Gulf Section of U. S. Shipping Board

across Lake Pontchartrain from the city, to-day, the hulls of a fleet of wooden merchant ships, exceeding 3,000 tons each, are nearing completion. Contracts have already been awarded for 5,000-ton steel freighters.

The city of New Orleans had just completed arrangements for financing a huge ship lock, an industrial basin and canal, in which additional fleets were to be built within the city limits and launched by the banks of the Mississippi River.

So New Orleans turned wholeheartedly to the Shipping Board's plan of training navigating and engineering officers and crews for America's merchant marine.

Rapid Expansion of the School

The United States Shipping Board Free Navigation School was first established in the offices of the Association of commerce. Swiftly it outgrew these quarters. The moment these cramped conditions were noticed Mayor Martin Behrman offered the Shipping Board a complete two-story building belonging to the city. This structure, the old Conveyance and Mortgage Building, was completely renovated under the direction of F. A. Christy, city architect, and March 1, 1918, saw the school housed in a building of its own. This gave New Orleans the distinction of being the only city in America to devote an entire building to the Shipping Board Navigation School.

Commodore Ernest Lee Jahncke was named by the U. S. Shipping Board as chief of the Gulf Section. For years he had been a leader among Southern yachtsmen. His title comes from his post as Commodore of the Southern Yacht Club, next to the New York Yacht Club, the oldest organization of its sort in America. He is a former president of the New Orleans Association of Commerce. Out of Louisiana's waterways the house of Jahncke has made its fortune. Commodore Jahncke has built the great shipyards now in operation at Madisonville. There to-day four 3,500-ton steamboats built of Southern pine are on the ways, and are close to the launching date. But despite the tremendous pressure of his private interests, Commodore Jahncke has accepted the post of Gulf Section Chief at the nominal salary of $5 per month.

Captain Ernest E. B. Drake, a deep-sea sailor, holding a master's certificate in the American merchant marine, accepted the post of director of the U. S. Shipping Board Free Navigation School. His assistant is Walton Smith, another practical deep-sea navigator. Those men, since the opening of the school, have poured a steady stream of qualified navigating officers into the American merchant marine. Their record is best summarized by one official report: not one man whom they have sent up from their school for examination before the U. S. Steamboat Inspection Service has failed to win his certificate.

The School Work

The navigation school is open from 8 a. m. until 11:30 p. m., daily. There is no set graduation day in that school. Each candidate for a mate's or master's certificate gets preliminary examination and individual instruction according to his needs. Ship models, compass, sextant, chronometer and patent log—all the equipment of a deep-sea navigator is available for instruction in that school. No man enters the school unless he has had two years' deep-sea experience. Within six weeks from his entrance, by this intensive system of instruction, each candidate has been thoroughly grounded in the basic principles of deep-sea navigation.

The work of the school is not, however, limited to the class room. Commodore Jahncke's gift to the school is the $60,000 (£12,300) steam yacht *Reverie*. This 130-foot craft, moored at the Southern Yacht Club on Lake Pontchartrain, makes regular trips into the Lake with classes from the Navigation School. There, out of sight of land, students of navigation get practical experience, under Captain Drake and Instructor Smith, in "shooting the sun," with sextant, in computing position with chart, chrono-

Entrance to U. S. Shipping Board Free Navigation School at New Orleans

Capt. Ernest E. B. Drake, Director of U. S. Shipping Board Free Navigation School, New Orleans, Instructing Class on Compass Deviation

meter and patent log, and are given exactly the training they need for their work later while crossing the Atlantic.

The number of students enrolled in the school varies. It maintains an average of between forty and fifty men.

While the navigating officers are being trained in downtown New Orleans, American marine engineers are getting their training necessary to obtain certificates as chief or assistant engineers out at the engineering school at Tulane University. There, under Professor J. M. Roberts, daily and nightly classes are put through a course that qualifies them for services in the engine rooms of ships crossing the Atlantic. All men permitted to enter this free engineering school must have had previous experience as firemen on ocean or coastwise steam vessels, as oilers or water tenders, as chief or assistant engineers on lake, bay, sound or river, as locomotive or stationary engineers. Or they must be graduates of nautical engineering schoolships, of technical school mechanical engineering courses, or must have served three years as apprentices to the machinist's trade. Approximately 30 men are constantly studying in these engineering classes in New Orleans.

Training Ship Assigned to New Orleans

New Orleans has also been assigned a training ship in which crews of the merchant marine are to be trained. The Shipping Board has not yet selected the craft which will be used in New Orleans, but word of this is expected daily.

In addition to these facilities for training men for the merchant marine, the United States Shipping Board Free Navigation School has been designated officially as a Sea Service Bureau. This means that graduates of the New Orleans school do not find themselves on the pavement hunting a job when their course of training is completed. The moment they are awarded their certificates as master or mate, engineer or assistant, they are assigned to duty on ships specified by the U. S. Shipping Board.

New Orleans since the earliest history of America has been a great seaport. Millions of tons of world trade have crossed the wharves of the 200-year old city. And now in the war crisis which has made an American Merchant Marine an imperative need if the United States is to play its part, New Orleans is working heart and soul not only to build ships but to train navigators, engineers and the crews who will officer and man them.

How to Order Pipe Fittings

In ordering fittings people not used to doing so can get into trouble by using terms unknown to the trade. If an inch tee is ordered, no mistake is possible; but these are made of cast or malleable iron, brass or steel, so it should be stated which material is wanted.

If what is known as "bull head" is wanted, the "run," as it is called, should be given first, then the outlet at right angles to the run, thus—1 inch by 1½ inches by ½ inch. There is another fitting which is virtually a tee but is not called so. It is one in which what is called the run differs greatly in sizes, say ¼ inch by 1½ inches by 1½ inches. This is called a 1½-inch ell with a back outlet. Ells can be obtained with side outlets. A sketch, however, with sizes marked thereon should be sent if there is any doubt in the mind of the one ordering.

Research in Marine Engineering*

How Lack of Research Has Retarded Progress in Marine Engineering—What It Can Accomplish

BY A. E. SEATON†

MARINE engineers have before them at all times and places certain phenomena—some familiar, others uncommon; these all have their causes and they themselves are generally effects. To understand them correctly more evidence is necessary than is generally supposed by the casual observer. It also often happens that among these engineers are men quite competent to observe and note all the facts and tender quite good evidence respecting them, but who are not so well fitted to arrive at the correct inferences to be drawn. But even if the means were available the men suitable for the work were not to be had; for those possessed of scientific knowledge and having had the necessary experience were generally too much engaged in following the avocation by which they lived to give the time necessary for laborious and patient research, without which the truth is sought in vain. Consequently we find many instances where important inventions have been conceived in the past, and even in some cases tentatively experimented with, but not brought to the perfection necessary for practical use until years afterwards, when the inventor and his supporters were beyond reaping any benefit from them, and all for want of diligent inquiry or examination in seeking the essential facts and principles involved in them. It will, therefore, be instructive to take a few well-known cases with an immediate reward for those who adopted it.

Development of the Screw Propeller

The screw propeller was proposed by Bramah as far back as 1785; it was tried by Littleton in a boat in 1794; fitted by Shorter to H.M.S. *Dragon* and *Superb* in 1802; but it was only dealt with seriously as a practical method of propulsion in 1836 in the steamship *Archimedes.* In H.M.S. *Rattler* in 1843 it was subjected to some further research by the naval authorities, which was carried out in such admirable, if costly, ways as to at last convince the public of what they might possibly have known fifty years before.

Now these *Rattler* experiments and many others made subsequently by the naval authorities with screw propellers are still sufficiently interesting and instructive to repay the student for examining them anew. It is certain that had they been examined anew in 1877 there would not have been perpetrated such a fiasco as happened with H.M.S. *Iris* in 1878.

No one, even with patient research, can now estimate the loss sustained by this country alone due to the dilatoriness in the "search for the truth" respecting the screw propeller which might have been employed for oceanic steamships with great advantage many years earlier than was actually the case. Nor can we have a true conception of the waste of fuel which went on year after year after the screw propeller was adopted from want of sufficient knowledge to design propellers so as to obtain the highest efficiency. Nor, on the other hand, can we estimate the great gain already actually attained by the patient, continuous, and scientific research made in this country and America, by means of experimental tanks, by the Froudes and other members of this Institution whose contributions are lasting monuments to their skill, diligence, and pertinacity in research.

Again, *the compound* engine, conceived by Hornblower in 1771, and improved by Wolff in 1804, was not fitted on shipboard till 1854 by Randolph and Elder in the *Brandon,* and in 1863 in H.M.S. *Constance.*

Another ten years elapsed before it was adopted for general purposes, and then somewhat grudgingly. This was really for want of something like true scientific research as against what passed muster for it, as may be seen in the Transactions of this Institution. There was later on a similar controversy and much heartburning over the triple compound engine, although it was introduced by so competent and scientific an engineer as the late Dr. A. Kirk in the steamship *Propontis* in 1874. Ten years later it was still being treated with considerable reserve.

Tardy Adoption of Triple Expansion Engine

The research conducted with patience and skill by Sir Alexander Kennedy, however, was sufficient in the end to break down prejudice and remove all opposition. Had such work as his been carried out thirty years before on similar lines with the *Brandon,* enough money could have been saved by the economy effected in fuel consumption alone to have gone far to pay the interest on the old National Debt. Besides, think how much mental energy was wasted in villifying systems such as the various compound engines, which real research could have rescued from the prejudice of opponents!

The surface condenser was part of Cartwright's patent of 1794, and also of Brunel's in 1822; it was, however, only in 1837 that Samuel Hall got one tried in a practical way in the paddle steamer *Wilberforce,* and also on the paddle steamer *Sirius,* the first steamer to cross from England to America. But a year or two after the surface condenser was laughed out of existence on grounds which, had proper research been made, would have been easily proved to have no real foundation for condemnation. For want of it, however, a quarter of a century after, both naval and mercantile ships were being still fitted with jet condensers, and years after that cross-channel steamers had them instead of the surface condenser now in universal use, and said to be able to effect a saving of fuel in those days of 15 percent. Think what that would have amounted to if the surface condenser could have been in general use from 1837 onwards!

Methodical research respecting the surface condenser has since then been carried out by Mr. D. Morison and Messrs. Weir, and has resulted in developments in its construction and use that have improved the power and efficiency of marine engines immensely.

But perhaps the most notable instance of delay in benefiting by an invention is that of the *steam turbine.* Branca so long ago as 1630 published the idea that a jet of steam impinging on the vanes of a wheel would make it revolve. He thereby established the foundation of the impulse turbine, just as Hero of Alexandria had so very much earlier

* Read at the spring meetings of the fifty-ninth session of the Institution of Naval Architects, London, March 21, 1918.

† Member of Council.

discovered a reaction steam turbine and employed it for useful purposes.

It was not, however, till two hundred and fifty years after Branca that, while Sir Charles Parsons was making his first experiments with the reaction turbine, De Laval, a distinguished Swedish engineer, followed Branca's idea and made an actual impulse turbine. But even then he apparently failed at first to appreciate Branca's art in placing the nozzle, which was in the form of a human mouth, far enough from the vanes to permit of sufficient expansion before impact. By further research De Laval discovered why his first nozzles were so inefficient, and consequently found how to make an efficient impulse turbine.

Where Research Would Have Helped

Why no engineer or scientist perceived that expanding steam had no other virtue than that due to pressure must, I think, have been really from want of proper research and perhaps also from the contentment that comes of a good sedative phrase or aphorism. Our forefathers were told by some wiseacre that "Nature abhorred a vacuum"; they believed it, and, what is more, acted on it by applying vacuum-making engines to pump water from mines, and succeeded.

And when another genius arose in Birmingham who discovered that a grindstone crank handle might be moved round by a reciprocating instrument, the mill engine came into use; and finally the marine engine appeared, like the mill engine, in the form of a modified pumping engine, notwithstanding that a direct-acting engine had been used in one of the earliest attempts at steam propulsion (the *Charlotte Dundas,* in 1802).

It is true that many quite early (1787) attempts were made to rotate a shaft direct by a rotatory engine, but they were all of them designed to be worked by the pressure of steam, and none by the dynamic energy of it on expansion. In other words, they were all of them pressure and none of them velocity engines.

Having shown what want of research has failed to do, I will now venture on what may be called the positive evidence of the proposition.

It was by research that James Watt, himself not originally an engineer, made the discoveries that led to the great improvements he effected on Newcomen's engine, and later on by the same means he made further on his own designs even greater ones. It was by research that Stephenson's *locomotive* was transformed from being so extravagant in consumption of coal that even among collieries it could not work profitably into the engine as we know it to-day, for in all essentials there is very little difference between those engines and the locomotive of Stephenson's latter days.

Watertube Boiler Invented by a Doctor

The watertube boiler was the invention of Goldsworthy Gurney, himself a doctor, who made a very extensive and complete study of the instrument by which steam could be rapidly and safely generated and yet so light as to be carried on a road vehicle. His research is shown by his various patents, and the success of his road carriages marks how good most of them were. It was unfortunate for him and for us that this research was late in fructifying in the minds of others, for Parliament in 1835 (and we should remember it was an early Act of the Reformed Parliament) decided, against the evidence of experts, that four miles per hour was the safe limit of steam road-cars, and that a man in advance with a red flag was a necessary accompaniment. But for this Act motor cars, busses, and wagons would have been in general use before the railways were made.

The submarine, with which we are now so much concerned, is the result of long continued research. It is a far cry from Bushnell's and Fulton's early efforts of the beginning of last century to the wonderful submarines of the present day, and many were the steps from the crude attempts of those early days to the successes of to-day and many brilliant minds were at work upon the problem in the principal maritime countries of the world. Nordenfeldt and Garrett in England, Goubet, Zédé, and Laubeuf in France, Holland (the Irish schoolmaster) and Lake in America, Laurenti in Italy—to mention only a few of those who have contributed to solving the problem of submerged navigation—were all men whose success was largely due to an incurable thirst for that knowledge which is acquired by patient and diligent search.

The torpedo, an old idea in conception, was taken up seriously by a landsman, Whitehead, who by his research and perseverance made such a success of it that it was quickly added to the armament of our foreign navies.

The Steam Turbine

To Sir Charles Parson's perseverance and tenacity of purpose in carrying on methodical scientific research is due the practical and commercial success of the steam turbine. In friendly competition with him De Laval, Rateau, and Curtis have conducted research with the impulse turbine, and it is only by such means that they have attained success. Later on Sir Charles Parsons developed the idea of reducing the rate of revolutions of screw propellers to obtain high efficiency in them without reducing the rate of the turbine, by connecting the driver to the driven with toothed wheel gearing. The higher rate of revolution of the turbine now possible with such an arrangement has much improved its efficiency, so that the little loss due to the modern gearing has been much more than made up by the gain in general efficiency of the system.

By continued research other engineers have made the further improvement of double gearing whereby with a rate of revolution of screw as low as that obtaining in the large cargo steamer, the turbine itself may be run at as much as 4,000 revolutions per minute.

The balancing of reciprocating engines, initiated by Sir Alfred Yarrow, has by scientific research been made a fine art, with great advantage to all having to do with ships, and it was the means of evolving the four-crank self-balanced engine so much preferred in passenger and naval ships until the turbine superseded it for express services.

It will, perhaps, be an additional inducement to give scientific research its due if I go further and furnish an instance of how wrong things have been followed up at a great expenditure of time and money, most of which could have been certainly saved if the research had been methodical and scientific.

Of this waste of time and money, the so-called *hydraulic propeller* is a good example, for if a fraction of the money spent on this device had been devoted to a "diligent inquiry of the truth," the remainder could have been saved. The patent fees alone spent on proposals of this kind of propeller would have gone a long way to that end. But it was only after the Admiralty had fitted a small ironclad ship with Ruthven's internal propeller and demonstrated thereby how lacking it was in efficiency that the public could be convinced. Even then another and more costly form was tried some time after by the Dutch with equally disappointing results.

A shipowner once complained to me of the extravagance of his superintending engineer in spending $3,400 (£700) in one year on experiments which had been mostly failures. My advice to him was to let him spend much more, for, seeing there were seventy steamers under his supervision, it was more important for him to discover what things were wrong to have on shipboard, and avoid them even, than to ascertain those which were good. He could generally find out all about the latter without troubling himself to make special experiments.

My object, therefore, is to concentrate attention now on this research work as being not only necessary and interesting, but really remunerative in results and of great benefit both to the individual and to the public at large, and to show that it may be so even when the results are negative in character. Further, to ensure that, in future, research work shall not be left entirely to unaided and individual effort, or even to the collective effort which in the past has been only too often unmethodical and sporadic because unguided. To avoid this there must be found the means, the men, and the machinery for the following objects:

Objects to Be Sought

(1) Individual efforts and enterprise shall be encouraged, and when found to be in the right direction they may be assisted so as to be carried to a successful issue without loss of time.

(2) All individual efforts shall be as far as possible co-ordinated and combined, so that by united action higher efficiency and quicker development in practical results may be attained in solving each problem dealt with at the least cost.

(3) Definite and systematic study of each and every proposition that the marine engineer is faced with should be made in such a way as to be free from all personal prejudice or interest, and its development be proceeded with.

(4) To study the possibilities of every project with a view to the public good, so that inventions, or even mere ideas, when proposed may be examined with care, and tested by means which are wanting to the originators, whereby they may be dealt with adequately.

(5) To examine afresh many of the accepted axioms, aphorisms, and formulæ which now pass muster for use in marine engineering, in the light provided by modern knowledge, and by methods found successful in later years, in order to prove if they have been established and still remain on sure foundations or otherwise.

(6) To examine afresh the proposals and ideas contained in the old patent and other records with a view to winnowing from them the seeds of things which may now be cultivated and made to produce fruit, but which, when they were first proposed, could not be done from want of the means of manufacture.

If research can accomplish these things for us, it will amply repay any reasonable sum spent on it, just as it has done in other fields where it has been properly applied, although they were far more restricted than are ours. In the meanwhile, however, we can perhaps, with the greatest advantage, follow on the sound and practical lines adopted by Sir Alexander Kennedy with such marked success a few years ago. We can at the same time avail ourselves of the extensive installations in the physical laboratories of our colleges and technical schools to carry out many investigations, and do much useful work. Such investigations of various kinds have already been carried on in many of them with advantage, but for want of co-ordination they have not been always so productive of engineering good as they might otherwise have been.

While on this topic, it may be well to warn you not to expect too much from experiments with models of engines or of any machinery on too small a scale, for defects which, in them, will be practically microscopic may and often are in the real thing, when in use, a great and overwhelming cause of trouble. With a suitable and efficient staff and the necessary means, a school of marine engineering research should be available for practical investigations on shipboard as well as on shore, whereby shipowners could have their troubles investigated and the efficiency of their machinery tested, whenever occasion demands, in ways impossible by the ordinary engine-room staff, from want of time that can be diverted from their regular and necessary duties to that required for such work. Moreover, there is the difficulty arising from their inability by both training and temperament to act with sufficient and critical discrimination, so necessary for it to be carried out thoroughly.

The work done at home in the ordinary physical laboratories can be made more useful and instructive than hitherto if directed from one sympathetic center which can co-ordinate the results obtained, and which, when necessary, will subsidize the work.

In our educational establishments there is, however, and I suppose must always be, "the daily round and common task," required not only by the educational authorities, but such as is necessary for so training the students that they may acquire proficiency in the rudiments as well as in the methods of research.

Real research does not in itself amount to much, but I venture to think that, such as it is, it might do so if directed by a special authority to ensure that the investigations are carried out in a systematic way, and that all are co-ordinated so as to afford complete evidence by which to arrive at correct conclusions. Moreover, in making these investigations the pupils will, I believe, be more interested and probably learn more from them than by merely following the stereotyped courses usually followed by order of the governing authorities.

Research Work Should be Directed by Special Authority

Of another thing we may be pretty certain: that in these days of strenuous and unremitting work research can no longer be left in the hands of those engaged in manufacture or professional work of the ordinary kind, nor indeed are many of these best fitted by temperament and training for the patient, methodical work required for investigations. But they are, however, eminently fitted by their knowledge, experience, and daily occupations to direct and control such work as is necessary for the administration, both monetary and otherwise.

That so many inventions have been made by men not of the profession nor previously engaged in engineering work, seems to me convincing proof that the class of mind best suited for research and discovery differs largely and fundamentally from that which in other men succeeds in directing successfully all kinds of work, men, and other operations. Hence I suggest the differentiation indicated above. Bramah was a blacksmith and maker of locks; George Stephenson was a fireman; "Screw-propeller" Smith, the man who patented a good workable propeller and got the *Archimedes* built, was a farmer; Samuel Hall was in the lace trade; Goldsworthy Gurney, a doctor. The inventor who exhibited an internal combustion engine a hundred years ago at Cambridge was a parson, as was also Ramus, the inventor of the hydroplane ship; James Watt was an optical instrument maker; the inventor of the chronometer, and winner of the

King's prize for it, was a gardener; "Increasing-pitch" Woodcroft was a librarian; Bessemer was an artist; Armstrong a lawyer; and even in our own day we have had very many valuable additions made to our knowledge by men outside the profession, which all goes to show how much more liberal we are than the members of those other professions who would monopolize that adjective for their own.

For administrative purposes, therefore, such a committee as that over which I have the honor to preside* would be a very suitable one, consisting as it does of members of every branch of the marine engineering profession, selected by the various institutions interested in marine engineering progress, and having on it also representatives of such bodies as the Board of Trade, Lloyd's Register, the Bureau Veritas, and British Coroporation. To them might be added with great advantage representatives of the Admiralty, the Indian and Colonial Governments.

A suitable staff with a director at its head would be also necessary; but I do not propose to deal with such details, as for the present I am chiefly concerned to win from you the acceptance of the principle that there should be some definite body to take up seriously the direction of the work of research in all marine engineering matters, and further that there shall be no longer any delay in forming such a body *ad hoc*.

British Research Department

Many of you no doubt are aware that an important Government Department was constituted in 1915 under the title of "The Committee of the Privy Council for Scientific and Industrial Research," and that it is assisted by an Advisory Council as well as by Standing Committees on engineering, metallurgy, mining, and other applied sciences.

A fund of one million pounds has been placed by the Government at the disposal of the Research Department to encourage British industries and to undertake research work generally, but so far I am not aware that any of it is earmarked or otherwise reserved for any undertaking that may be considered as marine engineering, notwithstanding that the importance of this branch of industry to British and Colonial maritime interests should entitle it to a considerable share of such a grant.

It appears, however, that it is proposed that certain bodies or associations in various localities representative of the local industries shall co-operate with the Council of Research, and that the cost of such research work as may be undertaken in this way shall be partly defrayed from the funds subscribed locally by parties interested in the results and partly by grants from the Government Fund equal in amount to the subscriptions. In this way marine engineering may possibly come in for recognition.

On the Main Advisory Council we find one of our distinguished vice-presidents, Sir Charles Parsons, and representing the Admiralty as assessor to it is another vice-president, Sir E. H. Tennyson d'Eyncourt; while on the Standing Committee on Engineering this Institution is directly represented by Sir Archibald Denny and indirectly by some of our members who represent other institutions interested in marine engineering.

We can be sure, therefore, that the interests with which this Institution is so clearly connected will not be entirely overlooked, and that to whatever use the funds thus furnished are put and whatever great opportunities are thrown open, naval architecture and marine engineering will have their fair claims for consideration fully satisfied.

The Engineering Committee referred to above have furnished a list of subjects thought to be suitable for our immediate research in marine engineering. The field covered by this list is so wide and instructive as to emphasize all that I have said in support of the necessity for research in marine engineering, and I cannot do better than append it to this paper and commend it to your consideration.

Subjects for Consideration Suggested by the Advisory Council for Scientific and Industrial Research

1. *Marine Engines.*
   - (*a*) Consumption per indicated horsepower or ship horsepower of various types of engines.
   - (*b*) Accuracy of torsion meter experiments.
   - (*c*) Efficiency of gearing of various kinds between engine and line shafting.
   - (*d*) Limits of peripheral speed for gear wheels.
   - (*e*) Application of roller or ball bearings to marine engines.
   - (*f*) Lubrication of stern tubes.
   - (*g*) Best kind and shape of nozzle for impulse turbines.
   - (*h*) Superheat and its effect on cylinder materials.
   - (*j*) Cylinder cooling (internal combustion engines).
   - (*k*) Further investigation as to the value of water injections.
   - (*l*) Internal combustion turbine engines.
   - (*m*) Lubricating oil for high temperatures.
   - (*n*) Most efficient management of condenser cooling surface and extraction of condensed water.
   - (*p*) Air pump efficiency.
   - (*q*) Centrifugal pump efficiency.
   - (*r*) Feed heaters, efficiency of various types.
   - (*s*) Best methods of preventing lubricating oils from entering boilers.
2. *Marine Boilers and Fuel.*
   - (*a*) Direct coal burning on grate.
   - (*b*) Atomized coal dust firing.
   - (*c*) Oil fuel.
   - (*d*) Oil burners for boilers.
   - (*e*) Boiler tubes.
   - (*f*) Transmission of heat.
   - (*g*) Lagging of boilers and steam pipes.
   - (*h*) Mechanical stokers.
3. *Constructional Materials.*
   - (*a*) Metal for turbine blades, impulse or reaction, saturated or superheated steam.
   - (*b*) Mixtures of iron for internal combustion engine cylinders, valves, valve seats, etc.
   - (*c*) Casting under pressure.
   - (*d*) Gun metal: heat treatment of, etc.
   - (*e*) Non-corroding alloys.
   - (*f*) Bearing metals.
4. *Refrigerating.*
   - (*a*) Methods and application.
   - (*b*) Distribution of refrigerated air.
   - (*c*) Insulating materials.

A hole drilled in a piece of metal or a slit was good enough perhaps for wire and sheet metal gages before the micrometer came into use, but why stick to such obsolete methods to-day? Consider the blessing it would be and the trouble it would avert if all sheet and rod diameters were given in thousandths of an inch instead of by number, which means nothing. A great anti-slit and hole movement is urgently needed.

* The British Marine Engineering Design and Construction Committee.

Letters from Marine Engineers

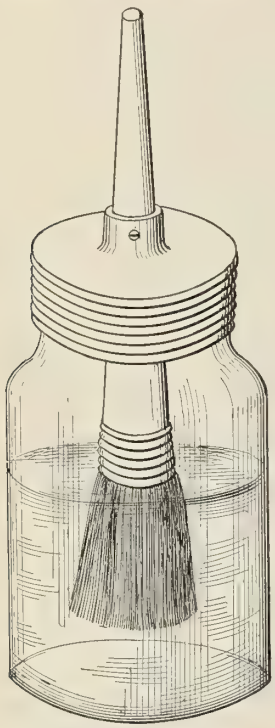
Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Shellac Container

In order to keep the bristles soft, the brush used for painting shellac must be kept immersed in the shellac when not in use. To leave the top of a shellac can or pot open means that the top surface of the shellac will at once become hardened over.

To cure these troubles try the scheme shown in the sketch. Buy a round, tapered handle brush; procure a



One Way to Keep the Bristles of a Shellac Brush Soft

quart Mason fruit jar with a screw top; drill a small hole about the size of the end of the taper handle in the center of the cover. Enter a taper drift from the inside, and with a light hammer form the bell or collar; then the brush handle is forced into this neck until it is in the position shown in the sketch. A couple of small head wood screws are used to secure it. This gives an excellent air-tight container.

C. H. Willey.

Learn to Like Your Work

Some fellows look upon their jobs as merely an exchange of work for the dollars that are necessary to procure their bread and butter and other necessities. Too often their only thought is how much they can get for the least amount of effort. Often some men find themselves compelled to make good, and that compulsion proved a blessing; they had no idea that they could develop talent until thrown into the position of sink or swim.

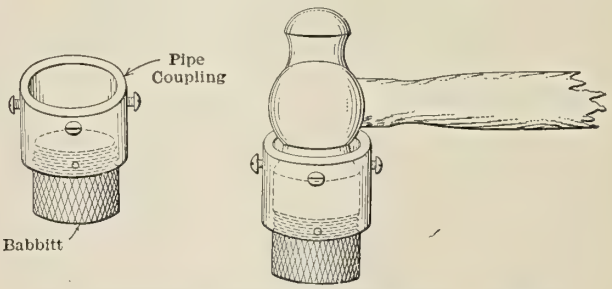
Some men have the natural gift of grasping things, while others clumsily plod along, depending on the more intelligent to direct their efforts. It is easy to note those who like their work and find in it more than monetary returns. If you could have followed the big men of today from their humble start right on up the ladder to the top, it would be your verdict that they won because they loved their work and had an undying desire to master it.

Chief.

Improvised Soft-Faced Hammer

This is a stunt that a traveling repair man showed to the writer; and while it is not as good as a regular soft copper or all-babbitt hammer, it does serve the purpose for which it was made. When a fellow has a whole raft of tools to carry, a kink like this that makes one hammer do the place of two is worth while.

The thing is made from a pipe coupling. Get one that will slip over the hammer face; drill and tap four



Arrangement for Attaching Babbitt Face to Hammer

holes for small round head screws, then set up the coupling in an earthen or clay mold, and pour it half full of babbitt about an inch over the top. The threads of the coupling serve to anchor the babbitt, but a small pin can be used to help.

Now you have a soft face for your favorite hammer and one which will not mar up brass or polished work.

Assistant.

Formulas for Determining the Sag in Wire Used to Aline the Bearings of Propeller Shafting on Board Ship

Piano wire of approximately 1/32 inch diameter is suitable for lining up propeller shaft bearings. It has a tensile strength of about 300,000 pounds per square inch cross-sectional area, so that a 1/32 inch diameter will support a 200-pound weight. The weight of this wire per lineal foot is .003 pound.

The curve made by the wire sagging is known as a "catenary"; but the formula for the sag in a catenary is most complicated and does not seem susceptible to arithmetical treatment, so that we have recourse to a formula for another curve, which, it is said, gives results almost

identical with those obtained from the formula for the catenary curve. This is the formula:
In which

$$h = \frac{W L^2}{8 \times W}$$

h = the distance of sag in feet, or parts of a foot, at the middle of the curve, measured *down* from the horizontal,
L = the distance (horizontal) between supports of the line in feet,
w = the weight in pounds per linear foot of the wire,
W = the tension in pounds endured by the wire, obtained by a weight suspended over a pulley,
8 = a constant.

As an example, let

L = 250 feet,
w = .003 pounds,
W = 200 pounds.

Then, applying these values to the formula given, we have:

$$h = \frac{.003 \times 250^2}{8 \times 200} = .117 \text{ foot},$$

or 1.40 inches, closely. This is the sag in the center between supports, measured downward from the horizontal.

Now, to find the sag at any place other than at the center, the following formula may be used:
In which

$$y = h \times \frac{x^2}{(\frac{1}{2} L)^2}$$

y = the sag at any place, other than at the center,
h = the sag at the center, as found from the first formula given,
x = the distance in feet from the center the point of measurement is made,
L = distance between supports, as given in the first formula.

For example, suppose y is required when x is 10 feet, h = .117 foot and L = 250 feet.
Then

$$y = \frac{.117 \times 10^2}{(\frac{1}{2} \times 250)^2} = \frac{11.7}{15{,}625} = .000748 \text{ feet};$$

but this must be subtracted from the .117 to get the distance sought, for the distance y is measured *upward* from a horizontal, whereas the distance h was measured *downward* from a different horizontal. So that

$$.117 - .000748 = .116252 \text{ foot},$$

and 12 × .116252 = 1.395024 inches sag, 10 feet either side of the center of curve.

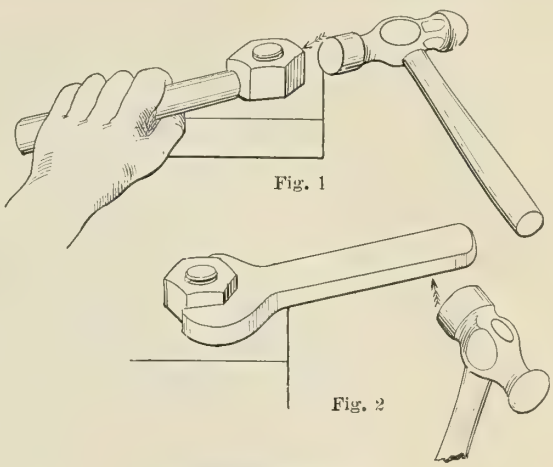
Scranton, Pa. Charles J. Mason.

Removing Frozen Nuts

At first thought, it seemed too much like kindergarten stuff to write up an article on how to remove stubborn or frozen nuts, but the writer thought: "Well, there are a lot of youngsters, firemen, oilers and beginners who read Marine Engineer and they may get a pointer or two out of it." So after sketching away awhile and seeing that certain bits of information about how to tackle a stubborn nut could be illustrated, I batted out the following:

The first thing to do when you meet up with a nut that doesn't want to come off is to see if there are any extra threads sticking through, that is, any of the body of the bolt or stud. If so, these threads must be cleaned free of rust with a three-cornered file, or, better yet, if it is possible, take a hack saw and cut the top of the bolt or stud off flush with the nut. I have noticed many men neglect this point, and with a big wrench they would proceed to twist off Mister Nut, stud and all. It stands to reason that that part of the bolt sticking through, if in a place where it will corrode and rust, will become bigger than that part in the nut, thus the reason for following the above pointer.

After trying the above, if the nut will not start, try the method shown in Fig. 1, that of holding a piece of heavy

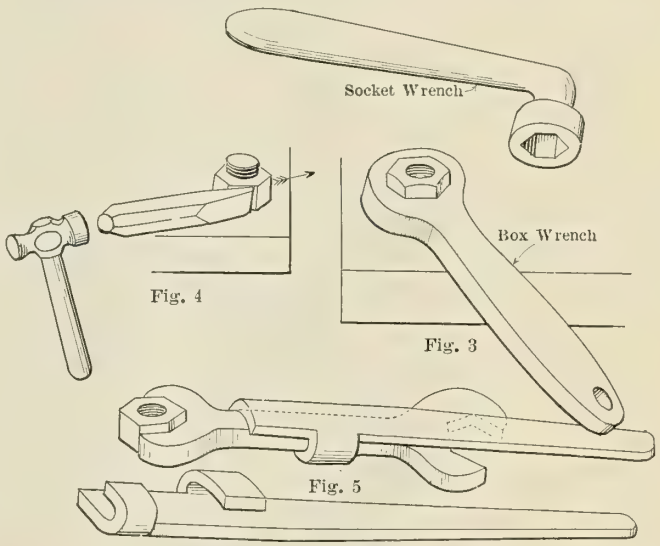


Loosening the Nut

stock against one side of the nut, and hitting jarring blows on the other side. Change the piece of stock around to another side of the nut and repeat the process. This rapping of the nut is in most cases very effective, and with patience the nut ought to come off.

After rapping, take a stout open end wrench and use as shown in Fig. 2. Set the wrench up against the nut good and solid and with a machinists' hand hammer strike sharp, smart blows.

The method of chiseling off stubborn nuts is a popular

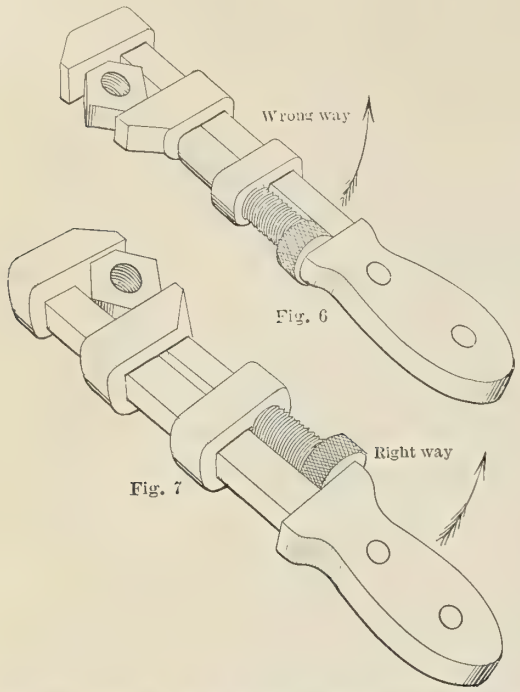


Chiseling Off a Stubborn Nut

one used by a great many engineers. A blunt tipped cold chisel is used at the angle shown in Fig. 4, and blows are struck that will drive the chisel against the nut in the direction shown by the arrow. This method is very effective but has the disagreeable feature of spoiling the nut for further use in a wrench and should only be employed where the nut is inaccessible to a wrench, or plenty of spare nuts are at hand.

To give added leverage to open end wrenches, there

are two means; that of flattening a piece of pipe so that a single-ended wrench will slip into it, and that of making a special lever for double-ended wrenches, as shown in Fig. 5. It should be remembered, however, that when one uses these extensions on the end of a wrench the



Right and Wrong Way of Using the Monkey Wrench

strength of one's muscles is greatly multiplied. If good judgment is not used, the stud or bolt will be twisted off.

The two types of wrenches shown in Fig. 3 are the best to use, if possible, on stubborn nuts, for they surround the whole nut, and, when working, grip the nut equally on all sides. They are especially adapted for use with the

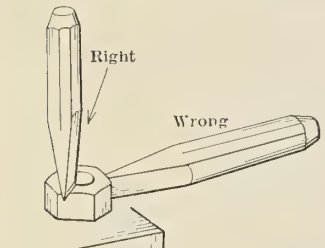


Fig. 9
TO SPLIT OFF A NUT

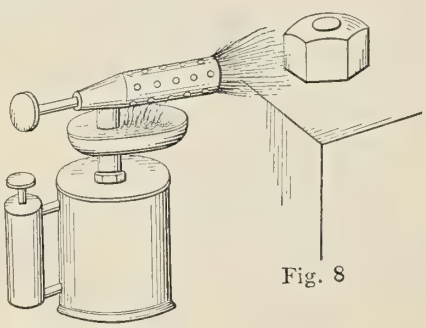


Fig. 8

The Last Resort

hand hammer, for they do not slip and chew the edges off the nut.

Figs. 6 and 7 show the right and wrong way to use a monkey wrench. These sketches apply to a right-hand nut. I have noted many good engineers use a monkey wrench the wrong way, and numberless times have I witnessed water tenders and firemen use one the way shown in Fig. 6. To cap the whole, they nearly always would be whacking it with a hammer. Monkey wrenches are good strong tools only when used properly.

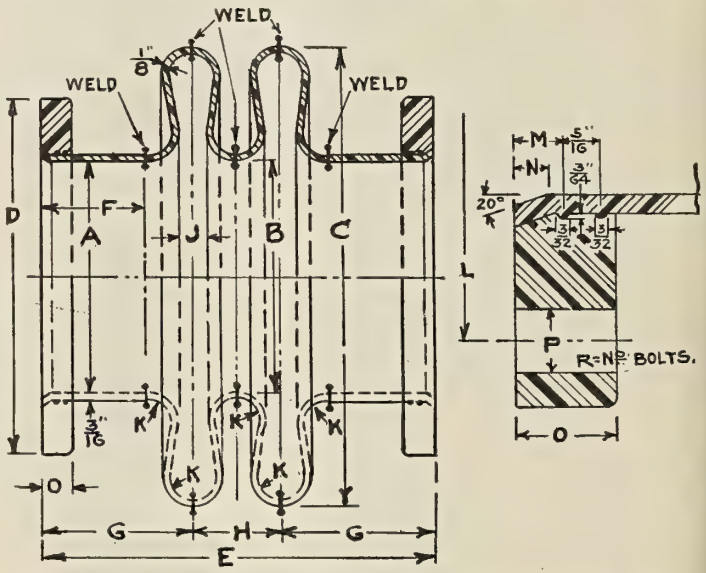
After trying these few kinks on the stubborn nut, there are but two methods left that seem worth while, that of soaking the nut and stud with kerosene (paraffin), and that of heating it with a torch, as in Fig. 8. Last of all, if it refuses to budge, it will have to be split off. There is a right and wrong way to do this. The wrong way spoils the threads of the stud or bolt and generally offsets it, due to the driving angle. The right way saves the bolt or stud and also gives a firmer backing up to the hammer blows.

Concord, N. H. CHAS. H. WILLEY.

Welded Steel Expansion Joint

The accompanying sketch and dimensions are for welded steel expansion joints for use in pipe lines passing through fuel oil tanks on ships and to compensate for expansion of the bulkheads.

Upon reference to the design it will be readily noted that this type of fitting is superior to the usual expansion



DIMENSIONS															
A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	R
4 1/2	4 9/16	9	8 3/16	7 5/8	2 1/8	2 15/16	1 3/4	11/16	7/16	7 1/16	13/32	9/32	7/8	1/2	10
6	6 1/16	11 3/16	10 1/8	9 5/8	2 5/8	3 3/4	2 1/8	7/8	1/2	8 7/8	13/32	9/32	7/8	5/8	12
8	8 1/16	16	12 3/8	13 1/2	3 3/4	5 1/4	3	1 1/4	3/4	11 1/16	17/32	13/32	1	5/8	14

Dimensions of Welded Steel Expansion Joints

fitting with stuffing box, as the fact that the packing required setting up would only be detected from leaking when the tank is full.

Steel tubing expanded into steel flanges form the ends. The expansion rings are made on a form and of slightly thinner material than the ends. Joints made to the dimensions in the table were subjected to a water test pressure of 100 pounds. A. H. NOURSE.

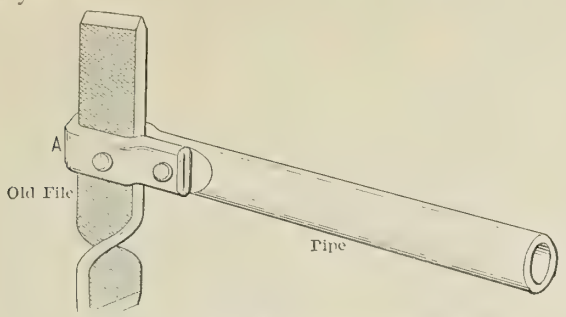
Brooklyn, N. Y.

Handy Scaling Tool

A very handy and inexpensive lot of scaling tools may be made from large size flat files that have become worn and unfit for further use and short pieces of ½-inch pipe. The file is heated cherry red and the tang cut off. A hole is drifted through the center of the file at *A* and while at a good heat the file is placed in a vise. With a

large wrench, it is given a 180 degree twist, as indicated at *B*.

Remember never to pound or work the file steel when the heat begins to darken. You will be liable to crack it if you do.



Scaling Tool Made from Large Flat File

The handle is made by flattening the end of the pipe for a few inches or more and forming the flattened part tightly around the file, lapping it back upon itself and then riveting it at both *C* and *D*. Sharpen both ends and the tool is finished.

Fireman.

Those Riveting Records

It would really seem that somebody should be saying something about these astonishing riveting records which are tumbling over each other in the daily press. We all know that for the winning of the world war the supreme demand is for ships. In the building of the ships the most responsible and the most continuously repeated operation is the riveting. Therefore, of course, speeding up the riveting is speeding up the building and increasing the output of ships.

It is, at first thought, most gratifying to note that a lively rivalry is current throughout the shipbuilding plants on both sides of the Atlantic for the making of riveting records, these being taken, of course, as indexes and guarantees of shipbuilding speed. They may be; but are they? It was said of the Charge of the Light Brigade that it was very brilliant but it was not war. So, without questioning at all the veracity of the current riveting records, we are tempted to say that they may be very brilliant but they are not shipbuilding, if indeed, they can be called riveting.

A shipbuilding pneumatic riveting record is not the record of one operative alone handling a single pneumatic riveter, even with changes or replacements of the tool from time to time. The man usually will be the head of a co-operating gang of six, comprising, besides himself, a backer-up, two heaters and two passer-boys. The making of a pace-making riveting record involves also many more than this riveting gang, who alone get the credit. As suggesting the mass of coincident work involved it is to be noted that the holes must be instantly and constantly ready for the rivets, so the numerous sheets and other members must be successively assembled and clamped in place with all the holes matching absolutely so that every rivet will enter without hesitation, and to make sure of this a plug must be tried in each hole and many of the holes must be reamed. These preliminary operations must all be carried on without getting at all in the way of the riveters. With all these conditions suggested to be complied with, and remembering the minor interruptions which inevitably occur, we are invited at the present writing to believe that in nine hours a single riveter has driven a number of rivets amounting to one every six seconds for the entire period. It paralyzes our believing apparatus.

It would seem to be very difficult for us ever to accept records of individual riveters, such as those now current, as assurances of ultimate shipbuilding speeds. Riveting records of another class are now coming along more deserving of serious consideration. These are the collective records per week, or other period, of all the rivets driven by all the riveters employed upon a single ship or upon a single shipyard way. This would tell us a real story of real shipbuilding, and the record would really tell not only of the actual performances of the riveters but of the co-operation of all hands to produce the desired results.—*Frank Richards in the Iron Age.*

NEW BOOKS

How Wooden Ships are Built. By H. Cole Estep. Size, 9 by 12 inches. Pages, 101. Illustrations, 200. Cleveland: 1918. The Penton Publishing Co. Price, $2.00 net.

While the art of wooden shipbuilding was not entirely extinct in the United States when the government undertook a year ago to build an immense fleet of wooden ships as a war emergency measure, nevertheless, the scarcity of men versed in this art created an insistent demand for practical information on how wooden ships are built. No books and very little literature on the subject existed, but the author immediately set about the collection of information and data covering current practice throughout the country. The result is a book largely descriptive of work actually being carried out rather than a scientific treatise of the subject. The mathematical theory of the ship design and other details which come more within the province of the naval architect than the shipbuilder have been omitted. The book describes the layout and equipment of wooden shipbuilding plants and the details and typical methods of construction of different types of wooden vessels as they are being built at the present time in the United States. As a supplement, two chapters on laying down wooden ships, from the treatise of the late Samuel J. P. Thearle, have been added.

The Naval Constructor. Fourth Edition. By George Simpson. Size 4¼ by 6½ inches. Pages, 880. Numerous illustrations. New York: 1918. D. Van Nostrand Company. Price, $5.00 net.

The new edition of this handbook is a repetition of the previous editions, except for the addition of some twenty-four pages of unity offsets of various steamers, a brief section of steam heating systems in ships and details regarding several new fittings and equipment.

Laying Off, or the Geometry of Shipbuilding. Second Edition. By Edward L. Attwood and I. C. G. Cooper. Size, 5¾ by 8¾ inches. Pages, 123. Illustrations, 121. New York: 1918. Longmans, Green & Company. Price, $2.00 net.

In the new edition of this standard text book, some portions of the text have been slightly revised with a view to greater clearness and some additions have been made. In particular, the solution of the hawse pipe problem has been modified so as to embody a theoretically correct method of projecting the generators of the cylinder. Several new examples have also been included.

Navigation. By George L. Hosmer. Size 4⅛ by 6¼ inches. Pages, 214. Illustrations, 43. New York: 1918. John Wiley & Sons, Inc. Price, $1.25 net.

This book has been prepared as an aid for candidates for officers' licenses in the American merchant marine. No theory or algebraic formulas have been introduced but only the simple working rules required for the daily routine of the navigator. The methods of computation have been illustrated by numerous examples.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

CONDUCTED BY H. A. EVERETT

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

There will appear in this column from time to time questions which have been asked by the Board of Steamboat Inspectors in the various examinations for engineers' licenses conducted by them. Such questions will be denoted by an asterisk (*) placed before the number if from examination for grade of chief, and by a dagger (†) if from examination for other grades.

Examination Questions

Q.* (983).—(*a*) With a low pressure cylinder piston 72 inches diameter, 10 pounds pressure in receiver, 26 inches vacuum, what pressure is on the crank pin to push or pull?

(*b*) A boiler 10 feet long is placed athwartships. When the ship is upright on an even keel there is 10 inches of water in the glass. When listed 15 degrees, how far is the water above or below the original height in the glass?

(*c*) If a strong wind shifts from the bow to the quarter and sail is made fast, will the engine turn faster or slower? Will it use more or less coal? Does sail save coal or not?

A.* (983).—Assuming barometer is 30 inches or 14.7 pounds. Ten pound gage = 24.7 pounds absolute. 26-inch vacuum = 2.0 pounds absolute. (Approximate.) Net pressure per square inch of piston area = 22.7 pounds.

Piston diagram = 72 inches. Area = 4,070 square inches, therefore total pressure on piston and on crank pin at beginning and end of stroke is 22.7 × 4,070 = 93,390 pounds.

(*b*) If the original water level is at a part of the boiler where the sides are approximately parallel, the drop or rise of the water in the glass is equal to the half length of the boiler, multiplied by the tangent of the angle of heel, as may be seen by accompanying sketch (Fig. 1). This would be for the case given

$$\frac{10}{2} \times 12 \times \tan 15^\circ,$$

or

$$60 \times 0.268 = 16.08 \text{ inches},$$

which probably means that the water would surge from, "out of sight," to "full glass," were its action not restricted or damped by the smallness of the fittings leading into it from the boiler. It should be borne in mind, however, that if the level is originally in a part of the boiler where the sides are not parallel, as near the top, where it is usually placed, this will not be true, as the inclined waterline will not then pass through the intersection of the half length and the original waterline. Its location must then be determined by taking account of the other dimensions of the boiler. It will be something like the line shown dotted in the sketch, and the level in the glass will fall less and rise more than in the first case. This is because the total volume of water contained in the boiler remains the same, and so the volume of the added wedge *L″OL′* must always equal the volume of the subtracted wedge *W′OW″*. It is interesting to note that obtaining a reading by taking the mean of the levels in the water glass will always give a value higher than the true water level if the glass is located above the middle of the boiler. This applied directly only to boilers of the Scotch type.

(*c*) Assuming the throttle pressure to remain constant, the engine will turn faster. It will use more coal per hour but less coal per trip. The engine will turn faster, thus using more steam per hour and therefore more coal per hour, the ship is driven through the water at an increased speed and the coal per knot is less. The engine

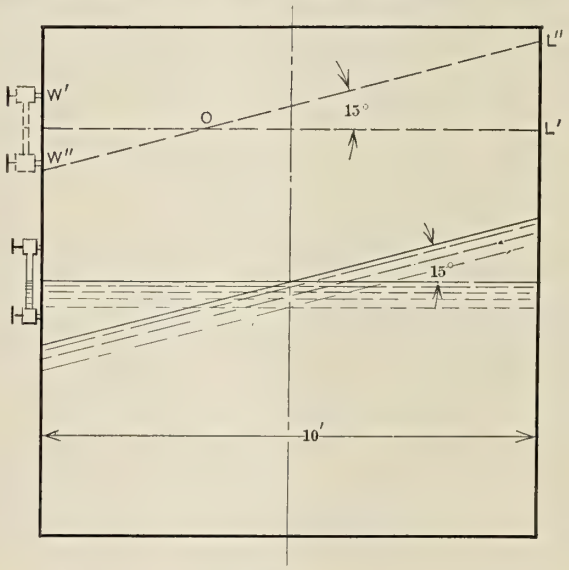


Fig. 1

will use more steam in about the proportion of the increase of revolutions per minute and the speed will increase also nearly proportional to the revolutions per minute. So that we have the engine working with an increase of power which has been proportional to the increase of revolutions per minute. To achieve the same increase of revolutions per minute, without the wind, however, would have required the engine to increase its power nearly proportional to the *cube* of the revolutions per minute. This difference of power is the gain due to the wind pushing on the sails and is equal to the pressure on the sails in the direction of motion multiplied by the speed of the ship, and divided by 33,000 if we wish to reduce to horsepower.

In actual practice, however, the effect is so slight that it is not worth the increased cost of maintenance, especially as with higher speeds of steamers the helping effect of the sails grows less.

Differences in Condensers for Reciprocating Engines and Turbines

Q. (981).—What are the differences in condensers for reciprocating engines and for turbines?

A. (981).—Mainly in details of construction. As turbines, of the condensing type, are designed to operate at higher vacua than reciprocating engines, the exhaust steam from the former has a greater volume than the latter. The tubes are so arranged as to allow little ob-

struction to the flow of steam; the area of the exhaust nozzle is made so as to distribute the steam most efficiently; the top rows of tubes are arranged so that the total clear space is approximately equal to the nozzle area. Also the horizontal cross section of the condenser are so designed as to give approximately a constant steam velocity from entrance to air pump suction and thus avoid a pressure gradient across the condenser.

Effect of Unbalanced Forces in Reciprocating Engines

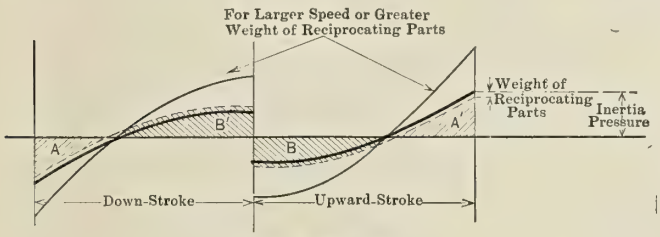
Q. (971).—(a) Assuming two engines of equal principal dimensions and arrangement which differ only in that the one is balanced by counterweights at the cranks, and the other not, will the former run at a greater number of revolutions to any appreciable extent or develop more brake horsepower?

(b) To make clearer what I am driving at, I desire to submit to you my analysis of this question.

An unbalanced engine sets up more or less vibration which is to be extinguished by the foundation, and which is, therefore, useless work or a wasted force. These free forces, prevented or reduced, as is the case on the balanced engine, should increase the power transmitted to the shaft.

(c) If the balancing of an engine is not desirable, but the weight of the reciprocating parts could be reduced, would such a step not tend in the same direction as balancing an engine? The free forces would be reduced and, therefore, we would approach the condition of a balanced engine. If this is the case, and the above assumption is right, then, by decreasing the weight of the reciprocating parts, the engine also will increase in speed. Am I right on that?

(d) Being unable to find a theoretical calculation of my assumption or to find a statement along my idea in the literature on balancing of engines, yet, as to account for such a possible increase of speed I also investigated the effect of the decrease in said weight on the inertia diagram. As an example, I assumed a vertical, single-acting (two-cycle Diesel) engine as being the simplest case, since every cylinder is alike and no valve motion is to be considered. But, looking at these diagrams,



Inertia Diagrams

it is evident that the *inertia forces* of the more or less weight of the reciprocating parts will not decrease nor increase the speed since the work of acceleration AN and B during one stroke of the piston is always equal the work of retardation A' and B' during the next stroke; i. e., the sum of these forces is equal zero, and therefore, in my opinion, the power of the engine is independent of the inertia forces, no matter how large they are.

As mentioned above, I cannot find a theory for the decrease in speed by either balancing an engine or decreasing the weight of the reciprocating parts of an engine, as this is said to have been experienced on quick-running engines. If you would be kind enough to give me some information along this line I will highly appreciate it.

A. (971).—When any engine is running, the forces of which are due to the *steam pressure* on the pistons and the load on the engine shaft are resisted by the stresses in the engine structure and are perfectly balanced, but the inertia forces of the moving parts caused by their continuous variation in direction and velocity are not automatically balanced, and unless cared for will set up vibrations. Balancing in engineering parlance is, therefore, the provision of means to neutralize these disturbing inertia forces. If the moving parts had no mass (or weight) these forces would be zero and the engine would still be perfectly balanced, but as they possess mass the unbalanced forces always exist. Rotating masses exert a continuous radial force due to the centrifugal force set up and reciprocating masses produce intermittent impulses in the line of reciprocation. If we balance these inertia forces (the first by equivalent rotating masses diametrically opposite and the second by equivalent reciprocating masses of opposite phase) theoretically the only thing which happens is that the shaking or vibration disappears and there is *no gain of power* whatever, for we have simply added inertia forces which neutralize those first called into existence, and neither the original forces nor their balancing forces were capable of doing useful work in rotating the shaft. This may not be obvious in the case of reciprocating parts, but consider that in one revolution you, on the down stroke, first accelerate the moving parts and then retard them and by nearly the same forces, but in opposite direction. If you take a complete revolution the sum of the acceleration and retardation for the two strokes is exactly zero. With this explanation, then, you will see that the answer to your first question is that theoretically the balanced engine will develop no more brake horsepower than the unbalanced engine for the same throttle pressure. Practically, of course, the elimination of lubrication troubles and other items, in addition to the elimination of vibration, make balancing desirable and necessary, and it is possible to run a balanced engine at higher speeds than an unbalanced one before the danger of breakage is reached. For example, a well-known automobile engine is advertised to give more power because it is balanced; but if you read the statement carefully the increase of power is obtained because *crankshaft distortion* has been eliminated by the balancing, and not any conversion of the inertia forces into useful work. The foregoing answers paragraphs (a) and (b) of your query.

Referring to paragraph (c), lightening the moving parts will have the same effect as partial balancing, but by balancing it is possible to eliminate vibration, while lightening reduces vibration, but cannot entirely eliminate it. As explained above, reducing the weight of the moving parts will not of itself increase the speed of power.

(d) The conclusion you reach here is quite correct.

Cooling Surface of Condensers Required

Q. (965).—Is the 2,000 square feet of cooling surface allowed in the condensers of the 1,500 horsepower vessels building for the Emergency Fleet sufficient? I think considerably more should be provided or the vessel will fail to meet requirements in service.

A. (965).—The allowance is sufficient, provided the plant is operated properly and the surface is well arranged in the condenser. One square foot per indicated horsepower is a rough working rule, which in the past has given ample surface for the general run of marine plants operating in all sorts of waters. Present practice in carefully designed units, arranged to avoid drenching of the lower tubes by the condensate from the upper and to direct the travel of the vapor, is to allow less surface than given above, even for very high vacua.

Radiation, Conduction and Convection

Q.† (975).—Describe radiation, conduction, convection.

A. (975).—Heat may be transferred from one body to another by three methods, radiation, conduction and convection, and usually all three methods are employed in the process, though each may exist separately. By *radiation* we commonly mean the heat or radiant energy which is propagated from the body in a radial direction by the ether vibrations; by *conduction,* the propagation of the heat energy by the *contact* of the particles; as the flow along a metal rod from hot end to cool end, and by *convection* the transfer of heat by means of some *conveyor,* as when a particle of air is heated from a hot body and then flows to a colder body and gives up its heat.

To illustrate, consider an object placed on a grid over a fire; it receives heat radiated (in straight lines only) directly from the glowing coals (radiation), also from contact with the hot grid on which it sets (conduction) and also from the hot gases which flow by it (convection). If it were on top of a closed stove the heating (from stove to object) would be by the last two methods only.

Shipbuilding and General Marine News

Contracts for New Ships—Shipyard Improvements—Engineering Projects—Improved Appliances—Personal Items

FIVE NEW YARDS AUTHORIZED FOR BUILDING CONCRETE SHIPS

Programme Calls for 42 Ships, Adding 298,500 Deadweight Tons to the Merchant Marine

Five new yards for the building of concrete ships and the construction of a total of 42 new concrete ships have been authorized by the United States Shipping Board.

Of these 42 concrete ships contracts for 18 have already been given by the Emergency Fleet Corporation. Contracts for the building of the remainder will shortly be let.

These 42 concrete ships will nearly all be tankers of 7,500 tons each, with a capacity of 50,000 barrels of oil. Each of the 7,500-ton ships will have 2,800 horsepower and a speed of 10½ knots.

Others of the concrete ships are cargo ships of 3,000 and 3,500 tons. The 42 concrete ships will have a total of 298,500 deadweight tonnage.

Location of the Yards

The five new yards are to be located, respectively, at Wilmington, N. C., Jacksonville, Fla., Mobile, Ala., San Diego, Cal., and San Francisco, where the *Faith*, the first concrete vessel, was built. There are also two private concrete shipbuilding yards, one at Brunswick, Ga., the other at New York City.

Cheaper Than Wood or Steel

The estimated cost of building a wooden ship is about $165 a ton complete, and that of building a steel ship about $180 to $220 a ton complete. The estimated cost of concrete ships is between $100 and $110 a ton complete. The difference is, it is claimed, brought about by the saving in equipment, time, labor and material.

Merchant Ships Launched in May Total 344,450 Deadweight Tons

American shipyards building for the United States Shipping Board launched in May 71 hulls, totaling 344,450 deadweight tons. This is a new high mark for launchings in the United States.

There were launched in May 39 steel ships, totaling 228,750 tons, and 32 wood ships, totaling 115,700 tons.

The May launchings exceeded those of April by 26 ships, or 122,520 tons; of March by 31 ships, or 89,360 tons; of February by 40 ships, or 174,650 tons, and of January by 55 ships, or 231,900 tons.

They also exceeded the highest monthly average of the United Kingdom—that of 1913—by 102,931 tons, the monthly average of 1917 in the United Kingdom by 199,325 tons, and they are within 57,886 tons of the American launching totals for the entire year of 1901, the record pre-war year in American shipbuilding.

350,000 Men Now Listed as Shipyard Employees

Expansion of American shipyards is indicated by the fact that the number of shipyard employees had passed the 350,000 mark at the end of May. On October 7 the total number of shipyard employees was 106,900. In seven months, therefore, the number of workers has increased by over 200,000.

Daily attendance in the yards has also improved, as shown by a record attendance in March of 98 percent in the wood shipyards and 84.9 percent in the steel yards.

Satisfactory as this development has been it is, nevertheless, expected that the number of employees will be increased by at least another 100,000 by midsummer.

TWO NEW SHIPYARDS FOR GOVERNMENT WORK

Pacific Coast Yard to Be Built by Bethlehem Shipbuilding Corporation

Two new shipyards, one on the Atlantic and one on the Pacific Coast, will be constructed with capital furnished by the Emergency Fleet Corporation. Preliminary announcements regarding the proposed plants indicate that each yard will have ten shipways, together with its own fabricating, machine, boiler, forge shops, etc. The fabricating and manufacturing capacity of the country is so well taken up with work for existing shipyards that the plans are to create new facilities for fabricating ship steel and building turbines, boilers and all ship parts.

The Pacific Coast yard will be built by the Bethlehem Shipbuilding Corporation, Bethlehem, Pa., at Alameda, Cal., on San Francisco Bay. This yard, with ten shipways and complete shops for fabricating hulls and building machinery, will be known as the Liberty Plant. The Atlantic coast yard is being held in abeyance, pending the completion of arrangements for housing the workmen.

The vessels to be built in the new yards, it is said, will be of about 9,000 tons deadweight. The lists for equipment for the new yards are being prepared, calling for sixty overhead electric cranes for the shops of each yard, in addition to tower whirler cranes for the shipways. It is understood that about 200 overhead electric cranes will be required and an equal number of hoists. In addition to this, from 60 to 100 punches, shears and other fabricating machines will be purchased.

SKINNER & EDDY CORPORATION LEASES PLANT OF SEATTLE CONSTRUCTION & DRY DOCK COMPANY

Big Merger on Pacific Coast Effected on June 1—Combined Yards to Build Merchant Vessels Only

By leasing the shipbuilding plant of the Seattle Construction & Dry Dock Company, Seattle, Wash., the Skinner & Eddy Corporation of Washington has become the most powerful shipbuilding organization on the Pacific Coast. Under the new arrangement, made effective June 1, the Skinner & Eddy Corporation will have in its employ a total of 12,000 shipyard workers. The operation of the combined plants will be directed by David Rodgers, general manager of the Skinner & Eddy Corporation.

Immediately following the merger of these two great yards, the Emergency Fleet Corporation placed an order with the Skinner & Eddy Corporation for steel ships valued at $100,000,000, providing sufficient work to keep the combined plants in Seattle in continuous operation for more than two years. The Skinner & Eddy plant now has fifteen direct contract 8,800-ton steel steamships to build for the Emergency Fleet Corporation, and the Seattle Construction & Dry Dock Company has direct contracts for ten 7,500-ton steel vessels.

The two plants occupy adjoining sites, each plant at present comprising 27½ acres. It is understood that the Skinner & Eddy Corporation has plans for extensive improvements of the combined plants, although statements to this effect have not yet been authorized by the company.

Part of the work previously contracted for by the Seattle Construction & Dry Dock Company, which was controlled by the Todd interests of New York, consisted of Government contracts for battle cruisers and torpedo boats. The naval work will be transferred to the Tacoma plant of the Todd interests, so that the entire facilities of the Seattle Construction & Dry Dock Company can be devoted to merchant shipbuilding.

Hull Draftsmen and Hull Inspectors Wanted by the Shipping Board

Men competent to fill the positions of hull draftsmen or hull inspectors are requested to communicate with the offices of the United States Shipping Board at Cleveland. Men experienced in hull work will find an excellent opportunity to aid the Shipping Board in these capacities.

EMERGENCY FLEET CORPORATION NOW ESTABLISHED IN PHILADELPHIA

Moving of Offices of the Emergency Fleet Corporation from Washington to Philadelphia, Begun June 1

With the leasing of the upper stories of the building at 140 North Broad street, Philadelphia, as a permanent home for the Emergency Fleet Corporation, steps were immediately taken to move the office equipment of the various divisions, as well as the effects of the employees, from their headquarters in Washington to the new home in Philadelphia. On June 1, by means of a fleet of ninety army trucks, the moving of the office equipment was begun.

To facilitate the moving, forwarding orders were distributed among the various offices of the fleet corporation. A 30-page pamphlet, compiled and distributed under the direction of A. M. Taylor, gave a list of accommodations from which persons connected with the corporation who are to move may make selections.

SCHWAB TELLS STEEL MAKERS OF RAPID STRIDES IN SHIPBUILDING

Over 250,000 Tons Completed in May—Rate of Production Will Be Rapidly Increased in Coming Months

At the annual dinner of the American Iron and Steel Institute, in New York on May 31, Charles M. Schwab, general manager of the Emergency Fleet Corporation, announced that the United States had put into commission in the month of May over 250,000 deadweight tons of merchant vessels. This output he confidently predicted could be taken as a minimum and that the monthly output would steadily increase.

Bearing out this statement, he stated, "During the past week we have contracted for new work aggregating $200,000,000 or $250,000,000, that will increase the shipbuilding capacity of the United States by at least three millions tons a year, and we will double that if necessary. We shall produce during this year 400,000 or 500,000 tons on the Great Lakes alone; but I think that is not enough, and in the coming year we can expect at least 1,000,000 tons from the Great Lakes.

"Last January there were 60,000 workers in the shipyards of the country. Today there are 350,000 and another 350,000 in the engine, boiler and accessory works."

Hog Island, Pa., Now the Address of the American International Shipbuilding Corporation

All communications to the American International Shipbuilding Corporation should be addressed to Hog Island, Pa. The corporation states that it is very important that this address be used, as the Emergency Fleet Corporation has moved into the building in Philadelphia where the American International Shipbuilding Corporation was formerly located. Unless all correspondence for the American International Shipbuilding Corporation is directed to Hog Island, Pa., much needless confusion is likely to result in handling its corespondence.

ENGLAND TO BUILD TWELVE NEW SHIPYARDS

One Hundred Shipways to Be Constructed to Accommodate Fabricated Steel Vessels Up to 15,000 Gross Tons

Information was received in Washington on June 5 that England has decided to build twelve new Government-owned shipyards, which will contain in all 100 ways. According to the British plans, fabricated vessels of steel only will be built in the new yards. These vessels will be of 12,000 and 15,000 gross tons each.

It was stated that the new yards will be constructed in Wales. This location has been chosen so that the present shipbuilding programme of England, which is situated chiefly on the River Clyde, will not be interfered with.

Large Canadian Shipyard to Be Built

The Dominion Iron & Steel Corporation is to erect a large shipyard in Canada for building ocean-going steel steamships. The new plant will cost from three to five million dollars, and will be ready for operation in from fifteen to eighteen months.

Plans have also been made for the construction in Canada of a plant for rolling steel plates with an annual output sufficient to meet the demands of Canadian shipyards for years to come. At present, orders have been placed in the United States for 80,000 tons of steel for ship construction, in accordance with an arrangement made by the Canadian Government with the United States Government.

Concrete Steamer Faith's First Sea Voyage

According to a telegram received by MARINE ENGINEERING on May 29, the concrete steamer *Faith*, six days out of San Francisco, with a full cargo, reached Seattle on the afternoon of May 28, on her way to Vancouver, after one of the roughest voyages on the Pacific Coast. Although the vessel encountered an 80-mile gale and waves 35 feet high, everything on board the vessel came through in good condition. Both the captain and government officials on board declared that the concrete vessel behaved as satisfactorily as any well-built ship of wood or steel and with little or no vibration from the machinery.

The *Faith* is not only the first ocean-going concrete steamship to be built in the United States, but is as well the largest vessel of this type to be built in the world. She has a cargo capacity of approximately 5,000 tons, and was built in San Francisco by the San Francisco Shipbuilding Company.

AMERICAN SHIPYARDS TO CELEBRATE THE FOURTH OF JULY BY LAUNCHING VESSELS

Each Shipyard Striving to Have One or More Hulls Ready for Launching on Independence Day

In accordance with a suggestion by Edward N. Hurley, chairman of the Shipping Board, arrangements are being made at every shipyard in the United States to launch one or more vessels on July 4, in celebration of the birth of the nation's independence. Latest advices indicate that a total of eighty-nine vessels, with a deadweight tonnage of 439,886, will be launched on July 4. Thirty-seven of these, with a deadweight tonnage of 254,686, will be steel vessels, and fifty-two, aggregating 165,200 deadweight tons, will be wooden vessels.

Chairman Hurley's suggestion was made in ample time to allow the shipbuilders to speed up their production schedule so that at least one vessel from each yard can be made ready for its initial plunge into the water on that date.

The McClintic-Marshall Company to Build a New Shipyard

The McClintic-Marshall Company, now operating fabricating steel plants at Rankin, Leetsdale, Carnegie and Pottstown, Pa., will build, at the request of the United States Government, two new fabricating plants for ship material; one to be located at Leetsdale and the other at Pottstown. Each will have a capacity for fabricating 10,000 tons of shipbuilding material per month.

The McClintic-Marshall Company will also build a large shipyard on the site of the former plant of the Ellicott Machine Corporation, Baltimore, Md., which will be operated by the company for building fabricated steel vessels.

St. Louis Preparing to Build Ships

Preparations for building sea-going vessels at St. Louis, Mo., are being made, and a group of capitalists and business men is waiting the word from Washington, according to the *Maritime Register*.

The St. Louis district is now manufacturing every major ship part except the heavy forgings and has an 8-foot minimum channel to the Gulf. In recent years it has become a producing center of open-hearth steel engines, boilers and Diesel motors.

George J. Baldwin, chairman of the Board of the American International Shipbuilding Corporation of the great Hog Island plant, has told St. Louis capital that St. Louis materials now being used in his Eastern yard ought to be assembled into ships in St. Louis, and that the 3,500-ton cargo boats now being built in the Great Lakes yards could be taken down the Mississippi at all stages, and that the 7,500-ton ships for cargo and transport could be moved under proper conditions on 8 feet of water.

The first plant to be erected will be capable of building four 7,500-ton vessels at a time. It will cost $1,000,000, of which one-half has been subscribed.

Wood Ship Design to Be Altered

Some alterations in the new wooden ships built for the Emergency Fleet Corporation are to be made that these vessels may be better adapted to carrying bulk cargo, it was announced on June 5. The decision to make these changes was reached following a conference between Chairman Hurley, of the Shipping Board; Charles M. Schwab, director-general of shipbuilding; P. A. S. Franklin, of the operating committee, and Charles Piez, vice-president of the Emergency Fleet Corporation.

Mr. Franklin was appointed to investigate the matter in detail, and for this purpose to visit some of the yards. It is believed that by altering the hatches and probably making some changes on the interior of the new wooden vessels they will be adapted to carrying coal to New England. This is the trade in which the Shipping Board is anxious to place the new vessels.

Through the efforts of Mr. Franklin's committee a considerable increase in the coal carried in the New England trade has been effected. It was learned that the coal carried to New England by steamer alone during May was 100,000 tons more than during the previous month. In addition, the coal carried by barge also increased.

Concrete Barges to Be Built in New Chicago Shipyard

A new corporation, the International Constructors, has announced that it will build a new shipyard in Chicago, where concrete ships will be constructed. The yard is to be on the south branch of the Chicago River, about where Twenty-ninth street would cross if it were cut through. The site is near the head of the Sanitary Canal. Theodore Ahlborn is naval architect of the new firm. Paul Gerhardt, formerly county architect for Cook County, Illinois, is active in the corporation. Mr. Gerhardt and Mr. Ahlborn have offices in the Schiller building, Chicago.

A novelty is to be tried by the company in its concrete boats. The sides and bottom will be made much thicker in a ship like the *Faith*, and will contain buoyancy chambers in addition to steel reinforcing rods. No frames will be visible, as they will be replaced by connections between the inner and outer walls of concrete.

It is expected that the new yard will be finished in a month or six weeks, and work will then be begun on 94 barges, with 120 tons carrying capacity each, that are to be used in the inland waterways of Illinois. The barges will bring coal to Chicago from the mines of the central and southern parts of the State and will carry back materials for use in factories. The tows will be made up of the towboat and four barges. The engines will be of the semi-Diesel or producer-gas types. As soon as the plans were made known St. Louis shippers announced they would like to follow suit with a line of barges on the Mississippi and Missouri Rivers.

There are to be three ways at the yard, from which the ships will be launched sideways. Later it is the intention to build steamers for the Great Lakes. These concrete steamers will be 241 feet long. Plans for their construction are ready.

All work at the yard will be done under cover. Buildings are to be put up which will have one movable side. This will make it possible to work with concrete both winter and summer. Concrete "guns" will be used on the sides of the ships and the bottoms will be poured by the hydraulic methods.

Drift Bolt Driver for Special Work

While shipbuilders are bending every effort to speed up each step of ship construction, the builders of the tools that play so important a part have not been idle. Their task is the development of new and better machines, so that a few seconds may be cut from the time required for each operation.

The Ingersoll-Rand Company's latest contribution is an air hammer especially designed for drifting up bolts. This tool enables one workman to do in a

Drift Bolt Driver with Telescopic Air Feed

short time that which would otherwise be a relatively slow task, needing two men. There is also the consideration that the new hammer makes the work far less fatiguing.

The tool in question is styled Ingersoll-Rand No. CC-251 drift bolt driver. Its distinguishing feature is a telescoping leg or air feed. This portion of the device consists of two sections of seamless steel tubing, one of which slides within the other, and is provided with an air-tight cup leather. Air when admitted extends the tool until it is against the bolt to be driven, where it is firmly held by air pressure while the bolt is being driven. A single three-way throttle controls both functions of the tool.

The hammer element is identical with that of that other member of the Ingersoll-Rand line, the No. CC-25 drift bolt driver. The new tool is very powerful, and will drive bolts of 1½-inch diameter up to 10 feet in length. It weighs 90 pounds, is 55 inches in length when air feed is closed and 77 inches in length when fully extended.

In its special field it is of distinct advantage and should be a welcome addition to the air-tool equipment of the yards turning out wooden hulls.

Ten Million Dollar Marine Terminal to Be Built at New Orleans by the Government

Government plans for warehouses, docks and terminal facilities at New Orleans call for the expenditure of ten million dollars. The project, work on which will be begun at once, will include three warehouses and a 2,000-foot pier and warehouse on the river adjacent to the canal. It is hoped to complete the warehouse by November 1.

The improvement will be of value to New Orleans, not only in affording it facilities for handling a greater amount of army shipments but for commerce after the war.

Dry Dock and Shipbuilding Plant for St. John

The development of the harbor in Courtenay Bay, St. John, N. B., Canada, as specified in the original contract of the Dominion Government with the Norton Griffiths Company, of Liverpool, which was commenced in 1912, but suspended at the beginning of the war, is now to go forward under the transfer of the original contract to the St. John Dry Dock & Shipbuilding Company, a new company composed of prominent Canadian ship owners and builders. The total expenditure of the contemplated works is estimated at seven million dollars. According to Counsel Henry S. Colver, of St. John, the present scheme involves only necessary expenditure for harbor necessities, the dry dock and the establishment of the shipbuilding industry on a large scale.

It is understood that the new company is to build the shipyard and lay the keel for the first 10,000-ton steamship within twelve months. The dry dock is to be completed in three years. The number of men to be employed is estimated at 2,000.

"Denison" Vapor Proof Fitting

The "Denison" fitting, illustrated, offers several new features for the exclusion of moisture, gases, etc. The dominating feature is the method of sealing the glass in the base. The seal is obtained by using a blown glass having an extended flange at the top. This flange is seated between two gaskets in a recess, which is formed in the base, and is pulled into position by means of a ring, which has co-ordinating threads which make up to the base, the recess being narrower than the thickness of the flange and the glass, thus compressing the glass firmly between the upper and lower gaskets. Instead of having a sealing surface of only the thickness of the glass wall, this seal is obtained between the two flat surfaces, to which great pressure can be applied, with the assurance, it is claimed, that it will be impossible for the seal to loosen or the glass to break with expansion. It is much the same principle as the standard "Union" fitting used in all marine work, except

Hoisting Engines Manufactured by the American Clay Machinery Company

no nicety of "fitting" is required, as the gaskets take up any irregularities that may exist between the several parts.

The ring or collar may be used as a shade holder for a reflector, as in the case of "Cargo" type of lighting unit, or for a guard, as shown in the cut. The wiring space is ample for all splices, and the socket is so made that all wiring can be done from the outside. It is not necessary to take the socket, socket

A Fitting Which Excludes Moisture and Gases

holder, etc., apart when connecting—a feature which alone is a great time-saver. The glass is blown instead of cast, and will allow for a great temperature variation without cracking, as in a case where water or spray will strike the glass while heated by a lighted lamp.

This unit is particularly adapted to work where economy of space and ruggedness is called for. It is made in sizes for lamps from 25 to 200 watts, and can be furnished in all standard pipe connections. It is manufactured by the Denison Electrical Fittings Company, of New York, and is handled exclusively by Frank E. Watts, 30 Church street, New York City.

Shipping Hoisting Engines by the Trainload

The accompanying illustration will be of interest to our readers, as it shows what can be done by a concern when it has the proper enterprise and personnel to take hold of such business on a large scale.

A short time ago the announcement was made in these pages that H. D. Van Doorn, 516 Liberty building, Philadelphia, Pa., had accepted the management of the newly-organized marine department of the American Clay Machinery Company, of Bucyrus, Ohio. In conversation with Mr. Van Doorn a few days ago, he informed us that this photograph, reproduced herewith, shows fifty of the hoisting engines loaded on ten cars, which the American Clay Machinery Company are manufacturing for the Emergency Fleet Corporation and others, and for which they have orders running into the thousands.

This photograph was taken of a partial shipment to the American International Shipbuilding Corporation at Hog Island, Pa., and represents two shipments leaving their plant at Willoughby, Ohio, on two consecutive days, and we understand that they ship these machines in large quantities daily. These hoisting engines are being installed on vessels all over the country, not only at the yards controlled by the Emergency Fleet Corporation, but also at a great many of the privately-owned shipyards. They have 9-inch by 9-inch cylinders and single drum, and are single-geared and fitted with a reverse valve.

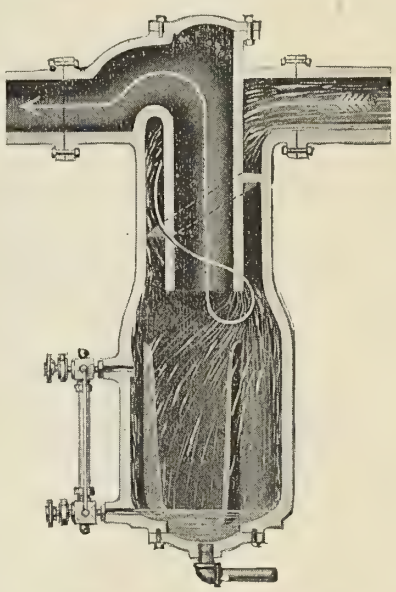
We understand that the American Clay Machinery Company are also manufacturing large quantities of windlasses, steering engines and capstans, and we hope to be able to illustrate them at an early date.

Meals to Be Wheatless on Lake Vessels

The wheat saving campaign was given a substantial boost by the recent announcement that all passenger steamship lines operating on the Great Lakes have decided to eliminate wheat from their menus until the next harvest.

Water Mechanically Removed from Compressed Air Lines by Stratton Air Separator

For the removal of water from compressed air, the Griscom-Russell Company, 90 West street, New York, N. Y., is manufacturing a new appliance known as the Stratton air separator. Water in compressed air is very detrimental to the



Section of Stratton Air Separator

proper operation of pneumatic tools, etc., and the Stratton air separator is designed to remove this water mechanically.

Centrifugal force is utilized as the means of separating the water from the air. As the water and air enter the separator they are caused to pass through a helical path formed about a central core. This helical path imparts a whirling motion to the air and water; and as water is several hundred times heavier than air, it is thrown out of the curving air current by centrifugal force. The water meets the wall at an angle without the slightest splashing action, and slips smoothly along, following close to

the wall until it reaches the receiver space at the bottom, at which point the swirling motion is checked by proper baffles.

The operation of the separator is purely mechanical, and it is, therefore, necessary that the air be of sufficiently low temperature to insure that all of the moisture is condensed. This is usually the case when properly cooled compressors are used or after coolers are employed.

Makes Push Switch Installations Steam-Tight

Double push button switches, because of their ease of operation, have always been popular, but their use has been restricted by reason of the liability of moisture, gas or dust getting into the operating parts. The Crouse-Hinds Company, New York, has designed and placed upon the market a cover with a switch-operating mechanism for use with these switches, when installed on condulets of either the FS or FD series,

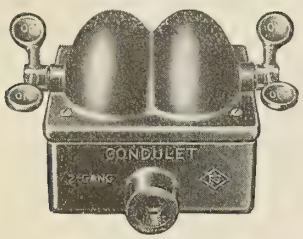


Fig. 1

which eliminates the objectionable features. This cover is made in one- and two-gang forms.

In Fig. 1 a two-gang cover is shown installed on a condulet, while Fig. 2 is of a single-gang condulet and cover, with cover unmounted. Like the condulet, the cover is a casting, either iron or brass, as specified. Iron covers are regularly finished in black enamel, although galvanized finish or any other plated finish

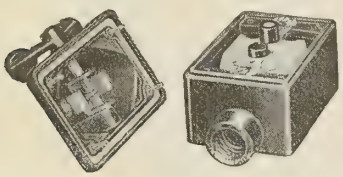


Fig. 2

will be furnished, if desired. Marine finish is standard for brass covers.

The mechanism which operates the push buttons is under the dome of the cover, and is controlled by a shaft, flattened at its inner end and extending through the side of the cover, where it terminates in the operating handle. That portion of the shaft which passes through the cover is provided with grooves containing hard grease, which effectually seals the bearing, and a rubber gasket likewise seals the joint between the cover and condulet. "On" and "Off" indicators, cast on the ends of the handle, facilitate the operation of the switch.

With this cover and the necessary condulet, it is now practical to use push switches in places where excessive moisture, explosive or corrosive vapors or fine dust circulate in the atmosphere, as in marine use, ammunition plants, refineries, textile and flour mills, and the numberless other locations which suggest themselves to the electrician.

Small Geared Turbines

To drive small electric lighting outfits, exciter units for large alternators, or for direct mechanical drive, there has been a demand for a line of steam turbines which would be constructed along the same lines which give durability, ease of adjustment and high economy to the larger turbine units. To meet this demand, which now comes principally from our new merchant marine for lighting sets, the Westinghouse Electric & Manufacturing Company has developed a line which is being manufactured in sizes from 15 to 50 kilowatts for direct-current service, from 30 to 50 kilowatts for alternating-current service, and from 30 to 100 horsepower for mechanical drive.

This machine is a geared unit, very compact and of rugged construction, as shown in the view of the direct-current unit, Fig. 1. The turbine operates at a speed of 7,200 revolutions per minute, and it is suitable for both condensing and non-condensing operation. It is built for normal operation on any steam pressure from 75 to 250 pounds, and for non-condensing operation on any back pressure up to 20 pounds. It embodies the three-point suspension principle, be-

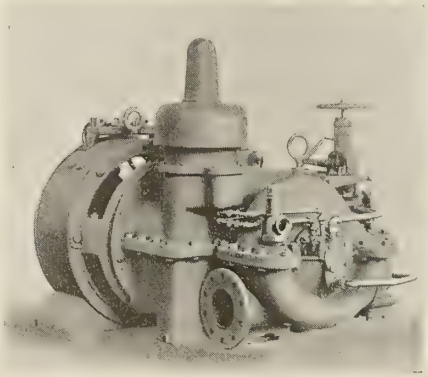


Fig. 1.—Direct Current Unit

ing supported by two lugs on the generator and one under the center of the turbine, thus maintaining, it is claimed, perfect alinement of the turbine, gear and generator.

The generator is of the well-known Westinghouse "SK" type, compound wound, with commutating poles. This design insures sparkless commutation even at heavy overloads without shifting the brushes—an important advantage, since no attention is required to adjust for changing loads. Coils are impregnated by the vacuum process, making them proof against even extreme dampness. The outboard generator bearing is supported by a single-piece bracket bolted to the frame. In this a steel shell lined with babbitt forms the bearing itself; it is pressed and pinned into place, and in case of trouble can readily be renewed by driving out with a heavy hammer. Oiling is by a ring running over the shaft and dipping into an oil well. The shaft may be pressed out of the armature without disturbing the connection between coils and commutator. Liberal spaces for ventilation are provided.

The internal construction of the turbine is practically identical with that of the larger machines. It consists of a single rotating wheel with blades or buckets around its periphery; the steam from the directing vanes or nozzles impinging against these blades causes the wheel to rotate and the work to be per-

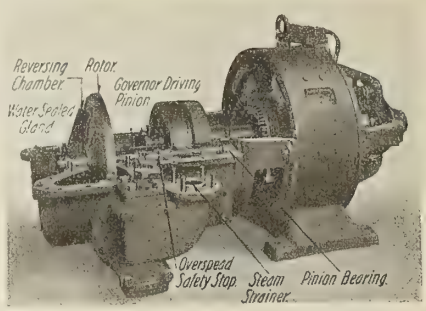


Fig. 2.—Geared Turbine Unit with Upper Casing Removed

formed. The full energy of the steam is extracted by using only one wheel with the aid of what is commonly known as the re-entry principle; that is, the steam, after passing through the blades the first time, is changed in direction by means of a reversing chamber and is directed against the blades a second time. The nozzle and reversing chamber are made of phosphor bronze, designed specially to resist the erosive action of steam at high velocities. In the 15- and 25-kilowatt units, the nozzle block contains but one nozzle, while in units of from 25 to 50 kilowatts capacity the block contains two nozzles, one of which is controlled by a hand-operated valve; at partial loads this valve may be closed, and thus the water rates are greatly decreased and a much higher efficiency is obtained.

Bearings on the turbine end of this machine are cast iron, lined with babbitt. Those on the rotor and pinion shaft are of the adjustable type; thus making it possible to keep a perfect alinement between pinion and gear at all times. The outboard generator bearing is a steel shell, lined with babbitt, pressed into the housing and pinned in place. It is ring-oiled. The pinion is milled out of the solid rotor shaft, thus entirely eliminating the coupling previously used to connect the pinion and rotor shafts.

These machines are fitted with standard water-sealed glands of brass, shrunk on the shaft. These glands seal the turbine casing around the shaft, and prevent steam from escaping when operating non-condensing, or they prevent air from entering when operating condensing. By using water glands in place of metallic or other similar glands, the friction loss is greatly reduced and wear is entirely eliminated, thus doing away with the replacing of parts at regular intervals, as is necessary with metallic glands.

It is a recognized fact that no governor is more reliable than the slow-speed governors used on Corliss engines. The governor on this unit is of the low-speed vertical fly-ball type, identical in construction with the governors on the larger units. This slow speed is ob-

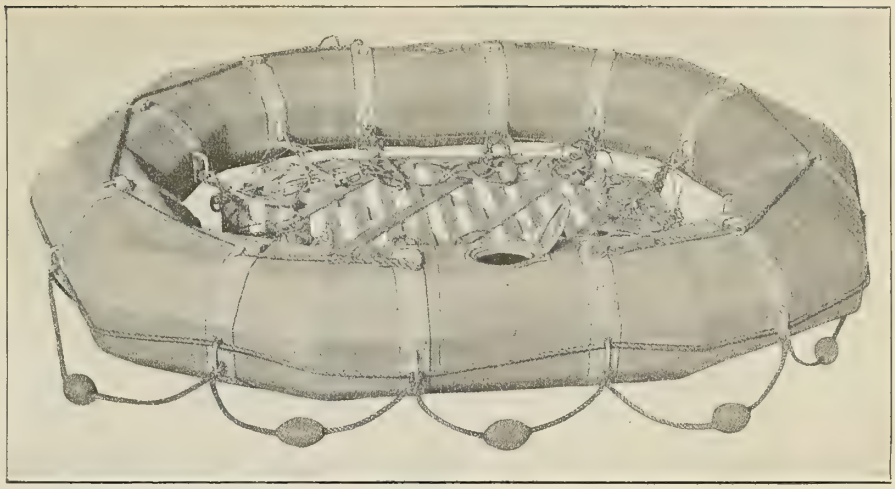
tained by driving the governor with a pinion on the slow-speed gear shaft. The fly-balls are pivoted on knife edges, and they are very sensitive to even slight speed variations in the turbine.

At the base of the governor, and driven by the governor spindle, is a gear oil pump, which furnishes the oil for both turbine and gear. The bottom of the gear housing is used as an oil reservoir, the pump lifting the oil from this reservoir to the top of the gear case, from where it flows by gravity through the oil strainer and to the bearings and other parts needing lubrication. The oil is kept cool by a copper cooling coil in the bottom of the oil reservoir, and through which cold water is kept continuously circulating.

One of the special features on this unit is the automatic throttle valve, operated directly from the governor by means of a connecting rod. This valve is of the balanced type and very sensitive in operation, thus insuring a close speed regulation.

One of the latest refinements provided on very few small turbines is the overspeed governor release. This is a simple device contained in a small hole drilled in the shaft between pinion and rotor. It consists of a cylindrical weight held in place by a coil spring surrounding it. In case the turbine should speed up to 10 percent above normal speed, the weight due to centrifugal force overcomes the spring tension and protrudes a short distance from its normal position. By so doing it comes in contact with a lug, which in turn is fastened to a lever, the movement of which trips the throttle valve catch and allows the valve to be closed by a heavy coil spring.

This line of turbo-generators conforms to the Navy Department's specifications for ship service, being provided in this case with both steam- and water-sealed glands and non-corrosive brass piping.



Cambridge Reversible Life Float

Cambridge Reversible Life Float

The Cambridge reversible life float, illustrated on this page, is elliptical in shape, the elliptical ring consisting of a copper tube with octagonal sides. The

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Oil Tanker *Herbert L. Pratt* Ashore Off Delaware Capes After Attack by German Submarine. This Vessel Was Subsequently Floated and Towed to a Repair Yard

copper tube is subdivided into air- and water-tight compartments by copper bulkheads, spaced 18 inches apart inside the tube. All lengthwise and crosswise seams of the copper tube are ½-inch standing seams of five-ply thicknesses of copper, formed by folding, pressing and soldering the edges of the sheets of copper. The copper tube is treated with asphaltum, and strips of wood, preferably bass wood, are placed over the copper. The wood is painted with navy gray waterproof paint, and securely fastened by metallic bands. The wood is then covered with a heavy canvas, from two- to four-ply thickness; two-ply being used on straight lines and four-ply on all joints where there are curves or turns. The canvas is thoroughly shrunk against it. The use and method of applying the strips of bass wood against the shell of copper give excellent protection to the shell and add to the durability of the apparatus. On account of the octagonal shape of the copper tube, greater buoyancy is secured than would be possible with a tube of circular section for the same size float.

The whole float, in proportion to its buoyancy and the number of persons that it will accommodate, is lighter, it is claimed, than any other float of the same dimensions. As the tube is made of a non-corrosive metal, covered with the most durable buoyant material known, it is claimed that the whole float will last practically indefinitely. Capt. Eugene O'Donnell, former supervising inspector

(Photograph copyright by Press Illustrating Service, Inc., N. Y.)

Charles Knight, Winner of the International Prize for Riveting Record at Bethlehem Shipyard, Sparrows Point, Md., With Helpers and Yard and Government Officials

and treated with waterproof paint. Galvanized metallic bands with handles, as shown in the illustration, are then affixed. In the center of each side of the tube, on both the top and bottom, are openings, closed with air- and water-tight brass covers, giving access to compartments for water, food, stimulants, pyrotechnic lights, first-aid appliances, etc. The floor board is rigged with heavy tarred manila rope, and is so arranged that no matter how the float lands in the water it is always right-side up, as both sides of the float are exactly identical.

The elliptical shape of the float, it is claimed, enables the float to be easily propelled or towed through the water. There are no sharp or pointed corners of any kind, all edges being curved and especially constructed for rigidity and strength. The metal bands around the tube give added strength and reinforcement to the whole structure; and as each band is provided with a handle, the entire float can easily be picked up and moved about or thrown off from the deck. The position of the handles is a factor of great value, not only as a support for persons in the water outside the float, but also as a buffer or protection between the copper tube and any heavy object coming up of the Fifth United States District of the Steamboat Inspection Service, who inspected the float under Government tests, recommends the float as a practical life-saving and non-capsizable appliance, made of the best materials, and, in his opinion, practically indestructible.

The Cambridge reversible life float is manufactured by Cambridge Reversible Life Float, Inc., whose works are at Cambridge and office at 40 Court street, Boston, Mass.

PERSONAL

H. A. EVERETT, professor of marine engineering, post-graduate department, Naval Academy, Annapolis, Md., and editor of the Questions and Answers department of MARINE ENGINEERING, has resigned, to accept the position of naval architect for the McClintic-Marshall Company, New York, which is establishing a new shipyard for building fabricated steel vessels in Baltimore.

ALBERT ED. SAUNDERS has resigned as naval architect of the Sun Shipbuilding Company, Chester, Pa., to become technical assistant to the president of the G. M. Standifer Construction Corporation, Vancouver, Wash.

A. WESTWATER, formerly chief engineer of the G. M. Standifer Construction Corporation, Vancouver, Wash., has opened an office as consulting engineer and naval architect in the Central building, Seattle, Wash. Mr. Westwater will represent the General Ordnance Company, of Denver, Col., which has contracts to build thirty-eight reciprocating marine engines for vessels under construction for the United States Shipping Board.

CHARLES T. BURTON, formerly assistant hull superintendent with the Standard Shipbuilding Corporation, New York, has been appointed hull superintendent of the Atlantic Corporation, Portsmouth, N. H.

VICTOR A. HARTLEY, formerly assistant foreman, boiler department, William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., has been appointed superintendent of the Badenhausen Watertube Boiler Company's plant at Cornwells, Pa.

H. A. HORNOR, consulting engineer in the marine electrical field, has been appointed head of the electric welding section of the educational and training department of the United States Shipping Board, with headquarters at 140 North Broad street, Philadelphia, Pa.

HUBERT C. VERHEY, chief draftsman of the technical department of the Emergency Fleet Corporation, has been appointed head of the marine Diesel engine department of the Fleet Corporation.

EDGAR C. RUST, secretary of E. H. Rollins & Son, has been appointed executive assistant to Howard Coonley, vice-president of the Emergency Fleet Corporation.

KARL R. KENNISON was recently transfered from the Bureau of Yards and Docks of the Navy Department to the Division of Shipyard Plants, Emergency Fleet Corporation, with headquarters in Philadelphia.

Edgar S. Closson, consulting engineer, Montclair, N. J., has been appointed resident engineer in charge of concrete shipbuilding for the United States Shipping Board Emergency Fleet Corporation at Mobile, Ala.

L. F. HARZA, formerly chief engineer in charge of design and construction of the 20,000-horsepower Canadian hydro-electric developer at Sault Ste. Marie, Ontario, has been sent to Jacksonville, Fla., by the Emergency Fleet Corporation to take charge of a Government concrete shipyard.

E. LOGAN HILL, assistant general manager of the Erie Railroad, has been granted leave of absence to serve as secretary of the United States Shipping Board Commission on Port and Harbor Facilities.

CHARLES A. MCCUNE has resigned his position as chief engineer of the Commercial Acetylene Company to become sales engineer with the Page Steel & Wire Company, 30 Church street, New York, where his efforts will be devoted to sales and service in connection with Armco welding rods.

OBITUARY

JOHN A. CONNOLLY, marine engineer and pioneer shipbuilder, died at his home in Brooklyn, N. Y., on June 2, aged 88. Mr. Connolly was the designer of many noted vessels of the last generation, among them the United States gunboats *Seneca* and *Chenango*, and the steamboats *Grand Republic*, *General Slocum* and *Columbia*.